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INVENTORY OF COAL MINE DRAINAGE SOURCES SELECTED AREAS, UPPER OHIO RIVER BASIN

Federal Water Pollution Control Administration
Wheeling, West Virginia

May 1969

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INVENTORY OF COAL MINE DRAINAGE SOURCES

SELECTED AREAS, UPPER OHIO RIVER BASIN

Work Document No. 32

This document has been prepared to record a specific water pollution control activity carried out to date in furtherance of the water pollution control program being developed in the Ohio River Basin. The information contained herein will serve as a ready reference to aid in the planning and development of the program in the Basin, for appropriate in-service training of participating personnel, and facilitating program activities with other cooperating groups.

Questions or comments relative to this material should be directed to:

Mine Drainage Unit
Upper Ohio Basin Office
Wheeling, West Virginia

UNITED STATES DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
OHIO BASIN REGION

May 1969

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TABLE OF CONTENTS

PAGE

INTRODUCTION ---------- 1

MINE DRAINAGE INVENTORIES

I. MINOR TRIBUTARIES TO OHIO RIVER

Wheeling Creek, Ohio ---------- 5
Captina Creek, Ohio ---------- 7
Raccoon Creek, Pennsylvania ---------- 9

II. CLARION RIVER TRIBUTARIES

Toby Creek (Elk County, Pennsylvania)---------- 12
Mill Creek, Pa. ---------- 14
Toby Creek, (Clarion County, Pa.)---------- 17
Piney Creek, Pa. ---------- 19
Deer Creek, Pa. ---------- 22
Licking Creek, Pa. ---------- 25

III. KISKIMINETAS RIVER TRIBUTARIES

Stony Creek, Pa. ---------- 28
Little Conemaugh River, Pa. ---------- 31
Conemaugh River, Pa. ---------- 34
Blacklick Creek, Pa. ---------- 36
Two Lick Creek, Pa. ---------- 38
Loyalhanna Creek, Pa. ---------- 40
Kiskiminetas River and Minor Tributaries, Pa. ------ 43

IV. MONONGAHELA RIVER TRIBUTARIES

Lower Monongahela River and minor tributaries, Pa. - 45
Redstone Creek and Dunlap Creek, Pa. ---------- 47
TenMile Creek, Pa. ---------- 49
Middle Monongahela River and minor tributaries, Pa.- 51
Dunkard Creek, Pa. - W. Va. ---------- 53
Upper Monongahela River and minor tributaries,
Pennsylvania - West Virginia ---------- 55
Buffalo Creek and Paw Paw Creek, W. Va. ---------- 57
Lower West Fork River, W. Va. ---------- 59

Tenmile Creek, W. Va. ---------- 61
Elk Creek, W. Va. ---------- 63
Upper West Fork River, W. Va. ---------- 65
Lower Tygart Valley River, W. Va. ---------- 67
Middle Tygart Valley River, W. Va. ---------- 69
Buckhannon River, W. Va. ---------- 71
Middle Fork River, W. Va. ---------- 73
Upper Tygart Valley River, W. Va. ---------- 75
Lower Cheat River, Pa. - W. Va. ---------- 78
Big Sandy Creek, Pa. - W. Va. - Md. ---------- 80
Upper Cheat River, W. Va. ---------- 82
Shavers Fork, W. Va. ---------- 84
Black Fork - Blackwater River, Pa. ---------- 86
Lower Youghiogheny River, Pa. ---------- 88
Sewickley Creek, Pa. ---------- 90
Middle Youghiogheny River, Pa. ---------- 92
Mounts Creek and Indian Creek, Pa. ---------- 94
Youghiogheny River West, Pa. ---------- 96
Laurel Hill Creek, Pa. ---------- 98
Casselman River, Pa. - Md. ---------- 100
Upper Youghiogheny River, W. Va. - Pa. - Md. ------ 102

TABLES AND FIGURES

PAGE

Table 1 - Summary of mine drainage loadings, selected areas, upper Ohio River Basin ---------- 104

Figure 1 - Index Map ----------

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INTRODUCTION

The Upper Ohio Basin Office, Wheeling, West Virginia assists with regional Federal Water Pollution Control Administration activities associated with its geographical area comprising parts of eight states. These activities include coordination of Water Quality Standards establishment and abatement activities, grants for waste treatment works construction, grants for development and operation of State water pollution control programs, grants for river basin planning, grants for research and development, manpower development and training, coordination of waste treatment facilities for Federal installations, regulatory programs, and technical support and assistance to other agencies and to the general public.

Within the scope of technical programs, and as a necessary component of river basin planning, the Mine Drainage Unit of the Wheeling Office has conducted extensive areal studies of the problem of stream pollution from bituminous coal mines. These studies have been directed to the broad objective of detailed identification of problem areas and inventory of significant problem sources within the 72,000 square mile area of the upper Ohio River Basin. Although mine drainage pollution source investigations have not been completed in the upper Ohio River Basin, this document is being prepared at this time in order to encourage the planning of abatement programs.

Problem area identification involves large-scale programs of stream investigations to quantify pollutional effects on the basis of hydrologic boundaries. Then, the mine drainage pollution source investigation follows by the meticulous inspection, almost on a foot-by-foot basis, of watershed areas earmarked for study. Such ground coverage is necessary because it is the usual case that the major portion of the mine drainage problem is from abandoned or inactive coal mine sites for which the record is scanty or absent. To date, about 20,000 actual and potential mine drainage pollution sources have been examined and/or technically described in more than 10,000 square miles of the upper Ohio River Basin.

With the exception of the Monongahela River basin, mine drainage pollution studies in the upper Ohio River Basin began

early in 1966. The inception of the long-term program was prompted by recognition of the under-emphasis given to this problem in the past, and, cognizance of the complex technical, economic, and political hurdles to be spanned to effect pollution abatement. The Wheeling Office mine drainage program was aided by the impetus of PL 89-4, the Appalachian Regional Development Act of 1965.

The program to date has been conducted in cooperation with, and in response to requests from state agencies, citizen action groups, local and regional planning groups, and other federal agencies. At the working level, the largest cooperative study has been conducted with the Pennsylvania Department of Health. In that state, a two-year field study of mine drainage conditions and sources in the Clarion and Kiskiminetas River basins, was recently completed. Personnel from the Wheeling Office and the Pennsylvania Department of Health performed the field assignments and reports of the venture will soon be published jointly.

Additionally, the interest and support shown in these pollution problems by existing or spontaneously organized local citizen-action groups have been instrumental in the changing of area study priorities. That is, in the case of any two polluted watershed areas, initial emphasis has been given to that area with a viable, sincere citizen organization or local governmental body dedicated to pollution abatement.

The Monongahela River Mine Drainage Remedial Project has provided major inputs for this document. This Project located in the Wheeling Office, was organized as a result of a water pollution enforcement action initiated by the Federal Government (U. S. Public Health Service at that time) in 1963 and involving the Monongahela River basin states. With the consultation and assistance of a Technical Committee representing the conferees to the enforcement activity, and an Advisory Work Group, the Project has for its objective, "....to determine the sources, types, and amounts of pollution from coal mines in the Monongahela River basin, means and cost estimates for abating such pollution."

Field inventory in the Monongahela basin has been completed and formal reports describing the inventory, and abatement

recommendations, are in preparation. The Project functions in cooperation with the basin states of Pennsylvania, West Virginia, and Maryland; and, the Ohio River Valley Water Sanitation Commission.

The content of this work document is a series of short narratives describing the severity and sources of mine drainage pollution in a number of upper Ohio River Basin watershed units, and, tabular summaries of the mine drainage source inventory of each watershed. The data presented is largely the result of a preliminary analysis of field data, and is subject to alteration or refinement upon closer analysis. Certain of the data have been completely analyzed and used in preparation of other work documents for limited distribution. These documents, prepared by the Mine Drainage Unit, Upper Ohio Basin Office, Federal Water Pollution Control Administration, Wheeling, West Virginia are as follows:

Stream Pollution By Coal Mine Drainage, Upper Ohio River Basin, Work Document No. 21, March 1968.

Stream Pollution By Coal Mine Drainage, Captina Creek Basin, Ohio, Work Document No. 23, March 1968.

Sources of Coal Mine Drainage Pollution, Wheeling Creek Watershed, Ohio, Work Document No. 25, June 1968.

Sources of Coal Mine Drainage Pollution, Raccoon Creek Watershed, Pennsylvania, Work Document No. 28, June 1968.

Recommendations For Water Pollution Control, Raccoon Creek Basin, Ohio, Special Report to Ohio Department of Natural Resources, November 1967.
(Not summarized in this document.)

Also of interest:

Water Supply and Water Quality Control Needs, St. Petersburg Reservoir, Clarion River, Pennsylvania, Allegheny River Basin, FWPCA, Ohio Basin Region, Wheeling Field Station, December 1967.

Formal reports utilizing the Clarion River and Kiskiminetas River watershed mine drainage data contained herein are in

preparation at this writing. Formal reports for all Monongahela River watershed units (29) are also in preparation.

Detailed chemical analyses, flow measurements, physical descriptions, and specific mine location data pertaining to the watershed descriptions in this document are on open file in the Upper Ohio Basin Office, Wheeling, West Virginia.

For purposes of the following discussions, a coal mine drainage source is defined as --- A surface or subsurface location resulting from the extraction or handling of coal, containing exposed mineralogic materials whose oxidation and solution by contact water results in highly mineralized drainage.

MINE DRAINAGE INVENTORIES

I. MINOR TRIBUTARIES TO OHIO RIVER

Wheeling Creek, Ohio
Captina Creek, Ohio
Raccoon Creek, Pennsylvania

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Wheeling Creek, Ohio

The Wheeling Creek watershed, draining 108 square miles of southeastern Ohio, has been extensively mined for the extraction of bituminous coal over the past 150 years. These activities have left hundreds of underground voids and large surface-mined acreages capable of producing acidic and mineralized drainage.

The water quality of Wheeling Creek is seriously degraded over nearly its entire length as a result of coal mine drainage. A portion of nearly every tributary to the main stream is affected by mine discharges. The water quality effects of mine drainage over the basin are generally those of excessive iron, sulfate, hardness, and total mineralization in the streams. Precipitation of iron compounds, particularly in Wheeling Creek, causes the additional problems of high turbidity and unsightly stream conditions.

Some 160 mine sites and an estimated 12,000 acres of strip-mined area were investigated during this study. Samples were collected from 120 drainage sources, 72 of which were discharging at the time of the survey. Discharges from the coal mine sources ranged from one to 306 gallons per minute (gpm) and totalled 2.1 million gallons per day. The pH values ranged from 2.3 to 8.4 and acidity concentration from 0 milligrams per liter (mg/l) to 20,950 mg/l were found. The mine discharges consistently carried high hardness, sulfate, and iron loadings.

Nine active mining operations were examined during the course of the field study. Active mining operations contributed only a small percentage of the total discharge volume and chemical loadings found. Strip mines and mine refuse areas contributed equally small percentages of the total. Inactive or abandoned underground (drift) mines are the principal mine drainage pollution sources in the Wheeling Creek watershed.

Fifteen principal mine drainage sources were found to contribute 72 percent of the sulfate loading and nearly 40 percent of the iron loading discharged to the watershed streams. It is estimated that physical abatement of these principal sources would produce significant water quality improvement in Wheeling Creek; however, at least one-half of the total number of sources would have to be abated to improve stream water quality to a tolerable level.

Mine drainage loadings
by source type
Wheeling Creek, Ohio

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Net Alkalinity (lb/day)	Total Hardness (lb/day)	Total Sulfate (lb/day)	Total Iron (lb/day)
Drift mines (inactive)	41	764	5,333	3,170	6,199	22,757	2,717
Strip mines (inactive)	12	245	771	158	2,447	4,081	262
Combination drift mines* (inactive)	13	256	7,425	555	2,288	15,528	2,301
Combination strip mines** (inactive)	3	29	165	15	229	611	81
Mine refuse areas	1	24	131	0	138	201	0
Active mines	2	155	137	224	2,020	6,048	650
TOTALS	72	1,470	13,962	4,122	13,321	49,226	6,011

*Drift and strip mines together with principal portion of discharge from the drift mine.
**Strip and drift mines together with principal portion of discharge from the strip mine.

Captina Creek, Ohio

Portions of the Captina Creek basin contain streams whose water quality has been degraded by mine drainage. The principal affected area is the lower reach of Captina Creek which is subject to backwater conditions from lock and dam operations on the Ohio River. Approximately the lower one to 1½ miles of the stream are affected by the ponding or retarded flow conditions. When the Ohio is in high flow conditions the backwater area extends further upstream. The stream is not normally acidic but is subject to periodic acid conditions (i.e., acidity concentration in excess of alkalinity concentration) from coal mine drainage.

Twelve points of mine drainage were located and documented as significant sources of mineralized discharges received by Captina Creek and its tributaries. The mine drainage emanates from active and inactive underground mines and mine refuse areas. An additional large number of inactive or abandoned mines exist in the watershed but were dry or causing only minor seepage at the time of inspection. Some of these mines undoubtedly contribute mine drainage to streams during wet periods.

Four of the 12 discharges were found to be acid in character and the total acidity load from all sources exceeded the total alkalinity of the sources by some 6,000 pounds per day (lb/day). Using the average lb/day loading values for comparison, the mine drainage sources contributed essentially all of the sulfate and iron content of Captina Creek and about one-fourth of the hardness content. The 6,200 lb/day of acidity discharged to the streams of the watershed is usually adequately neutralized by the stream alkalinity in Captina Creek. The total mine drainage source iron loading equalled 354 lb/day. The total mine drainage source flow measured was 257 gpm. Mine refuse areas are particularly potent sources of dissolved pollutants in the watershed.

Mine drainage loadings
by source type
Captina Creek, Ohio

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Hardness (lb/day)	Sulfate (lb/day)	Total Iron (lb/day)	Manganese (lb/day)	Aluminum (lb/day)
Drift mines (inactive)	3	45	134	178	368	31	-	12
Mine Refuse Areas (active)	2	43	6,371	756	5,673	49	40	1,271
Drift mines (active)	1	9	-23	22	49	-	-	-
Shaft mines (active)	5*	153	-279	543	1,147	274	2	4
Slope mine (active)	1	7	-44	114	136	-	-	-
TOTALS	12	257	6,159	1,613	7,373	354	42	1,287

*Includes multiple discharges from an individual mine.

Raccoon Creek, Pennsylvania

The Raccoon Creek watershed, draining 184 square miles of southwestern Pennsylvania, has been extensively mined for the extraction of bituminous coal for more than 100 years. These activities have left hundreds of underground voids and large surface-mined acreages capable of producing acidic and mineralized drainage.

Raccoon Creek and many of its tributaries are grossly polluted by coal mine drainage. Raccoon Creek possesses degraded water quality due to mine drainage from a point just downstream of the community of Cherry Valley (Washington County) to its mouth, about 40 stream miles. Additionally, an estimated 30 to 40 miles of tributaries are likewise affected. The streams over most of this total distance are acidic, highly mineralized, devoid of normal aquatic life, and unsuitable for many legitimate water uses. With the exception of Potato Garden Run, tributaries to Raccoon Creek polluted by mine drainage are restricted to Washington County.

Some 200 mining and related sites and an estimated 10,000 acres of strip-mined area were investigated during this study. Samples for chemical analysis were collected from 157 drainage sources, 142 of which were discharging at the time of the survey. Discharges from the coal mine sources ranged from one to 3500 gpm and totalled 15.1 million gallons per day. The pH values of the effluents ranged from 2.4 to 7.7, and total acidity concentrations as high as 6120 mg/l were recorded. Ninety-two percent of the mine discharges were acidic. The total acidity loading (less alkalinity) to Raccoon Creek and its tributaries equalled 81 tons per day.

Active mining operations, including one oil well, contributed less than one percent of the total discharges measured. Inactive or abandoned strip mines discharged about one-fourth of the total mine discharges and about 22 percent of the total coal mine acidity. Abandoned underground mines are the principal mine drainage pollution source in the Raccoon Creek watershed.

Twenty-eight principal mine drainage sources were found to contribute 87 percent of the acidity loading discharged to watershed streams. It is estimated that physical abatement of these principal sources would produce significant water quality improvement in Raccoon Creek; however, it is probable that at least one-half of the total number of sources would have to be abated to improve stream water quality to an acceptable level.

Mine drainage loadings
by source type
Raccoon Creek, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Hardness (lb/day)	Sulfate (lb/day)	Total Iron (lb/day)	Manganese (lb/day)
Underground mines (inactive)	31	5,453	57,229	27,021	107,194	5,048	556
Strip mines (inactive)	69	2,364	30,118	30,436	77,150	2,675	1,108
Strip mine (active)	1	4	84	30	125	4	3
Combination underground mines* (inactive)	30	2,087	69,144	24,864	102,858	10,620	914
Combination strip mines** (inactive)	9	315	5,001	3,608	10,824	317	150
Preparation plant (active)	1	30	869	475	1,663	117	25
Oil Well	1	46	63	242	770	40	2
TOTALS	142	10,299	162,508	86,676	300,584	18,821	2,758

*Underground and strip mines together with principal portion of discharge from the underground mine.
**Strip and underground mines together with principal portion of discharge from the strip mine.

II. CLARION RIVER TRIBUTARIES

Toby Creek (Elk County, Pennsylvania)
Mill Creek, Pennsylvania
Toby Creek, (Clarion County, Pa.)
Piney Creek, Pennsylvania
Deer Creek, Pennsylvania
Licking Creek, Pennsylvania

Toby Creek Watershed, Elk-Jefferson Counties, Pennsylvania

The Toby Creek watershed embraces an area of 125 square miles located in Elk-Jefferson Counties, Pennsylvania. The watershed is u-shaped and about 29 miles in length. Most of the watershed is located in mountainous terrain with elevations commonly exceeding 2000 feet above sea level.

The water quality of Toby Creek is seriously degraded over its entire length as a result of coal mine drainage. The water quality effects of mine drainage throughout the watershed are those of excessive acidity, iron, sulfate, hardness, and total mineralization in the stream. Although the majority of the acid mine discharges are located in the upper half of the watershed, the residual effects of the mine drainage parameters are evident over the entire length of Toby Creek.

During the summer of 1967 some 129 mine drainage sources were identified and sampled for chemical analysis. One hundred and twenty of these sources were discharging to watershed streams at the time of inspection. The total measured discharge was 9925 gpm or 14.3 million gallons per day emanating from coal mine sources within the watershed. The drainage areas of Brandy Camp Creek and Little Toby Creek above Kylers Corners represent the two areas in the Toby Creek watershed which are most seriously degraded by mine drainage. All of the twelve principal mine drainage sources are located within these two headwater drainage areas. Each of these twelve discharge points results from either an abandoned underground mine or a combination underground mine. Combination underground mines are those which have been interested by strip mines. The largest single acid load measured in the watershed resulted from an underground mine at a point where a stripping operation intersected the underground Kyler Mine complex. The acid load carried by this discharge was 4761 lb/day at a measured flow of 1323 gpm. The combined acid load of the twelve principal sources was 29,831 lb/day, about 80 percent of the total watershed acid load.

A total measured acidity loading of about 19 tons per day was discharged to watershed streams at the time of the source investigation. The highest acidity concentration found was 2370 mg/l from strip mine spoil piles. Acidity concentrations at the mouth of Toby Creek ranged from 62 to 236 mg/l while the pH value was consistently below 4.1.

Mine drainage loadings
by source type
Toby Creek watershed, Elk-Jefferson Counties, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Hardness (lb/day)	Sulfate (lb/day)	Total Iron (lb/day)	Manganese (lb/day)
Underground mine (inactive)	62	5,315	21,820	20,421	46,589	1,435.3	767.23
Underground mine (active)	3	200	103	898	1,059	17.1	1.32
Strip Mine (inactive)	26	622	1,214	1,969	3,641	16.40	56.99
Combination Drift mine (inactive)	28	3,786	14,287	15,584	33,898	842.20	694.53
Crop Seep	1	2	0	0	0	.20	.04
TOTALS	120	9,925	37,424	38,872	85,187	2,311.20	1,513.39

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Mill Creek Watershed, Pennsylvania

The Mill Creek watershed drains a 56-square mile area located in east-central Clarion and northwestern Jefferson Counties, Pennsylvania. The drainage area is divided about equally between the two counties. Generally, the topography varies little throughout the drainage area with hilltop elevations exceeding 1700 feet above sea level found in all portions of the watershed. Approximately 35 percent of the Mill Creek drainage area lies within Pennsylvania State Game Lands.

Above the confluence with Little Mill Creek, Mill Creek is virtually unaffected by coal mine drainage. Several tributaries to Mill Creek, in its headwaters area, had pH values as low as 5.2, however, no sources of pollution were found to account for these low values. Generally, the pH values of the headwater main-stem tributaries ranged from 6.0 to 7.4 with conductivity values varying from less than 50 to 140. Aquatic life was observed in many of these tributaries.

The watershed has experienced only limited amounts of mining activity, all of which appears to have been restricted to surface mining operations. During the 1967 source investigation, 16 sources of strip mine drainage and 3 gas well effluents were sampled. Additionally, 11 strip mine ponds were sampled, however, these ponds were not discharging at the time of inspection. The total measured discharge was 358 gpm or 0.5 million gallons per day emanating from coal mine sources within the watershed. The total source acid load measured in the watershed was 6795 lb/day.

Little Mill Creek is affected by mine drainage over its entire length, however, the sources contributing the highest acid loads are located in the lower portion of the tributary. Two of the four principal watershed sources are located on Little Mill Creek. The combined acid load of these two sources was 4582 lb/day. At its mouth Little Mill Creek had pH and conductivity values of 3.8 and 1500, respectively.

Two other principal watershed sources are located on two headwater tributaries to Jones Run. The watersheds of the two tributaries have been area strip-mined and only partially reclaimed. The tributaries are in continual contact with acid-producing materials as they flow through the disturbed area. The combined acid load amounted to 1800 lb/day.

The acid condition of Mill Creek, below the confluence of Little Mill Creek, persists the remaining distance to the mouth of Mill Creek. At the mouth of Mill Creek the acidity concentration ranged from 187 mg/l to 465 mg/l, while the pH value remained below 3.2.

Mine drainage loadings
by source type
Mill Creek watershed, Pennsylvania

Source Type	No.	Total Discharges (gpm)	Total Net Acidity (lb/day)	Total Hardness (lb/day)	Sulfate (lb/day)	Total Iron (lb/day)	Manganese (lb/day)
Strip mines (inactive)	15	340	6704	3137	9336	590.8	225.9
Gas Wells	3	16	77	97	188	11.8	7.7
Unknown	1	2	14	11	31	2.1	1.4
TOTALS	19	358	6795	3245	9555	604.7	235.0

Toby Creek Watershed, Clarion County, Pennsylvania

The Toby Creek watershed drains a 37 square mile area located in northeastern Clarion County. The creek flows south through the county to its confluence with the Clarion River near the community of Clarion, Pennsylvania. The watershed is relatively long and narrow in shape having a length to width ratio of about three to one. The axis of the watershed is oriented NE-SW and is approximately 13 miles in length.

The water quality of Toby Creek is continuously degraded by mine drainage from its uppermost reaches and over its entire downstream reach as a result of coal mine discharges. Mining activities in this watershed have generally been limited to operations located on the hilltops. Hilltop area-strip mines are especially common, many of which are associated with small drift mines. The mine discharges inventoried during the 1967 survey are distributed throughout the drainage area. As a result, the mainstream and many of the tributaries are characterized by pH values below 4.0. In addition to the coal mine discharges inventoried in the watershed, fourteen gas well discharges were located and sampled. An acid load of 511 lb/day was the largest load encountered from a gas well effluent. A total of 99 mine drainage sources were identified and sampled for chemical analysis. Eighty-three of these sources were discharging to watershed streams at the time of inspection. The total measured discharge was 2091 gpm or about 3 million gallons per day emanating from coal mine sources within the watershed. The total measured acidity discharge was 40 tons per day. This was the largest total source acid load measured in any of the six inventoried watersheds of the Clarion River basin.

Approximately 97 percent of the total source acid load, 18.5 tons per day, is contributed by 19 principal sources. Strip mines contributed 13 of these discharges, underground mines, four, and gas wells, two. Near the mouth of Toby Creek, a small tributary draining directly to the main stem has been area strip-mined in its headwaters. A 500 gpm flow, coming from the final cut of the strip operation, discharged an acid load of 25 tons per day to Toby Creek. The pH and conductivity values of this mine effluent were 2.8 and 8000, respectively. This is the largest discharge in terms of acid load encountered anywhere in the inventoried watersheds of the Clarion River, and accounts for 63 percent of the measured source acid load on Toby Creek. Acidity concentrations at the mouth of Toby Creek ranged from 735 mg/l to 1226 mg/l while the pH value remained below 3.1 at each sampling during the study period.

Mine drainage loadings
by source type
Toby Creek watershed (Clarion County), Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Hardness (lb/day)	Sulfate (lb/day)	Total Iron (lb/day)	Manganese (lb/day)
Strip mines (inactive)	43	1207	75,403	13,606	95,472	6,073.5	1,088.9
Underground mines (inactive)	26	539	4,324	1,789	7,111	130.2	162.8
Gas Wells (abandoned)	14	345	1,439	1,250	3,312	354.1	71.5
TOTALS	83	2091	81,166	16,645	105,895	6,557.8	1,323.2

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Piney Creek Watershed, Pennsylvania

Piney Creek drains 70 square miles of east-central Clarion County, Pennsylvania. The extreme northeastern portion of the watershed extends into Jefferson County, however, this is a very small portion of the watershed. The axis of the watershed is oriented east to west and is approximately nineteen miles in length. Topography within the watershed moderates considerably in the headwater areas.

Mining operations in the Piney Creek watershed are somewhat evenly distributed about the perimeter of the watershed. With the exception of that portion of the watershed south of Mechanicsville, Pennsylvania, heavy mining activity is noticeably absent in the interior portions of the watershed.

The uppermost headwaters of Piney Creek contain numerous sources of acid mine drainage whose discharges immediately degrade the water quality of the main stream. No further significant mine effluents are discharged to Piney Creek before the confluence with Little Piney Creek. Due to the neutralization effect of a number of alkaline tributaries, Piney Creek exhibited a pH value of 6.7 and a net alkalinity concentration of 5 mg/l above its confluence with Poe Run. Upstream of the confluence with Little Piney Creek, several tributaries including Poe Run, Glade Run, Sloan Run, and Parsons Run discharge waters to Piney Creek containing moderate amounts of mine drainage. The stretch of Piney Creek between the community of Kingsville and the confluence with Little Piney Creek supports a restricted aquatic life community. Below the confluence of Little Piney Creek, the main stem is continuously polluted due to mine drainage and is devoid of any aquatic life.

Little Piney Creek is seriously affected by mine discharges over its entire length with pH values as low as 3.2 and acidity concentrations as high as 270 mg/l recorded.

Brush Run is the most seriously acid-polluted tributary in the Piney Creek watershed. Stream gaging and sampling of this tributary showed pH values as low as 3.2 with acidity concentrations ranging from 280 mg/l to 430 mg/l. Precipitation of iron compounds has coated the stream bed over nearly its entire length.

During the 1967 source investigation, 130 mine drainage sources were identified and sampled for chemical analysis. Seventy-nine of these sources were discharging to watershed streams. The total measured discharge was 1623 gpm or 2.3 million gallons per day emanating from coal mine sources within the watershed. The total measured source acid load was 5.5 tons per day. Twenty-four sources within the watershed discharged acid loads exceeding 100 lb/day. These sources are classified as principal watershed sources and contributed an acid load of 4.8 tons per day, 87 percent of the total watershed acid load. Strip mines and combination underground mines contributed the largest acid loads. The highest single acid load inventoried in the watershed was 1542 lb/day from a strip mining complex located near the headwaters of Piney Creek.

During a 1966 stream survey Piney Creek at its mouth carried an acid load ranging from 388 lb/day to a maximum of 61,165 lb/day during the survey period. The acidity concentration ranged from 72 mg/l to 218 mg/l while the pH value remained below 4.0 at all times.

Mine drainage loadings
by source type
Piney Creek watershed, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Hardness (lb/day)	Sulfate (lb/day)	Total Iron (lb/day)	Manganese (lb/day)
Strip mines (inactive)	35	791	5,469	7,571	14,607	306.1	540.5
Underground mines (inactive)	22	273	1,843	1,461	3,470	163.0	107.5
Combination strip mines* (inactive)	4	9	94	97	224	1.5	6.9
Combination underground mines** (inactive)	9	334	2,211	3,405	5,573	146.2	208.1
Strip mines (active)	3	118	1,281	1,872	3,563	41.2	72.7
Coal washery (inactive)	1	1	19	6	28	2.7	0.3
Gas Wells (abandoned)	5	97	59	307	424	16.5	7.0
TOTALS	79	1,623	10,976	14,719	27,894	677.2	943.0

*Strip and underground mines together with principal portion of discharge from the strip mine.
**Underground and strip mines together with principal portion of discharge from the underground mine.

Deer Creek Watershed, Pennsylvania

The Deer Creek watershed embraces an area of 69 square miles located in north-central Clarion County, Pennsylvania. In the lower portion of the watershed the valleys are v-shaped and the hillsides steep and abrupt. In the upper portion the topography moderates considerably as the valleys widen and hillside slopes decrease. The axis of the watershed is oriented NE-SW and is approximately 18 miles in length. Paint Creek is the principal tributary to Deer Creek and drains 40 square miles of the total 69 square mile drainage area.

Mining operations in the Deer Creek watershed have been almost exclusively limited to hilltop or flat land stripping with very limited activity in the valley bottoms. Nearly all of the strip mines located in this watershed are area-strip mine operations. With the exception of an approximate 15 square mile area just north of Shippenville, Pennsylvania, mining operations are evenly distributed throughout the watershed. Discharges from abandoned gas wells were found to be significant sources of acid pollution in the watershed. Eleven such sites were found during the field investigation and sampled for chemical analysis.

The water quality of Paint Creek, principal tributary to Deer Creek, is seriously degraded by coal mine drainage and abandoned gas well effluents in its headwaters area. Strip mine discharges located north of Frills Corners, Pennsylvania, lower the pH value of this tributary to 2.6. Two gas well effluents near Tylersburg, Pennsylvania contributed a combined discharge exceeding 700 gpm to a tributary of Paint Creek. The 218 lb/day iron load carried by these discharges imparts a high degree of discoloration which is evident over the entire downstream reach of the tributary. Frills Run and Step Run are two additional Paint Creek tributaries degraded by gas well effluents.

Gas well discharges were not encountered along Deer Creek or its other tributaries, however, gas well activity did occur in this portion of the watershed. The degraded water quality of Deer Creek above Paint Creek is attributable to acid mine discharges in the headwaters area.

During the 1967 source investigation 89 mine drainage sources were identified and sampled for chemical analysis. Fifty-nine of

these sources were discharging to watershed streams. The total measured discharge was 1403 gpm or about two million gallons per day emanating from coal mine sources within the watershed. The total measured source acid load from the discharging sources was 5.4 tons per day. The 11 abandoned gas well discharges contributed over two tons per day of acidity to the watershed streams. Thirteen principal watershed sources were identified, seven of which were coal mines, four were gas wells, and two additional sources whose exact origin is unknown. The acid loading from the thirteen principal sources was 4.4 tons per day, 80 percent of the total watershed acid load. The largest single acid load in the watershed was 1995 lb/day from an abandoned drift mine. The largest gas well acidity loading was 1722 lb/day.

During a 1966 stream survey, Deer Creek carried an average acid load of five tons per day at its mouth. The acidity concentration ranged from 101 mg/l to 157 mg/l and the pH value remained below 3.4.

Mine drainage loadings
by source type
Deer Creek watershed, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Hardness (lb/day)	Sulfate (lb/day)	Total Iron (lb/day)	Manganese (lb/day)
Underground mines (inactive)	17	69	3,621	551	4,560	356.60	58.62
Strip mines (inactive)	15	44	1,197	437	2,541	291.00	42.03
Combination Underground mines* (inactive)	9	55	745	470	1,137	150.10	25.08
Combination Strip mines** (inactive)	2	4	69	46	114	9.40	2.70
Gas Wells (abandoned)	11	1,073	4,154	3,981	9,146	957.00	152.59
Oil Well (abandoned)	1	25	60	100	180	10.50	3.06
Coal Washery (active)	1	60	324	442	734	25.90	9.50
Unknown	3	73	610	609	1,172	317.40	11.39
TOTALS	59	1,403	10,780	6,636	19,584	2,117.90	304.97

*Underground and strip mines together with principal portion of discharge from the underground mine.
**Strip and underground mines together with principal portion of discharge from the strip mine.

Licking Creek Watershed, Pennsylvania

Licking Creek drains a 52 square mile area of southwestern Clarion County. The topography of this watershed is less severe than that found in the other inventoried watersheds of the Clarion River basin. Generally, the valley bottoms are wider and hillsides are less steep and abrupt. Hilltop elevations seldom exceed 1500 feet above sea level. Cherry Run is the largest tributary in the watershed with a drainage area of 21.3 square miles.

The Licking Creek watershed has experienced extensive mining activity in all portions of the drainage area. Numerous underground mines have been located throughout the watershed, however, later surface mining operations have destroyed most of these old underground mine sites. The majority of the active strip mine operations were engaged in restripping operations. Only one small active drift mine was in operation during the 1967 source inventory. The Licking Creek watershed contains more unreclaimed strip mine acreage than any of the remaining five inventoried watersheds in the Clarion River basin. This is partly attributable to the greater number of acres disturbed by strip mining but it also appears that much of the strip mining was performed at a time when only minimal reclamation was required.

The water quality of Licking Creek is degraded over nearly its entire length as a result of coal mine drainage. Craggs Run was the only major tributary which exhibited alkaline conditions during the source inventory. Little Licking Creek, Mineral Run, Anderson Run, and Cherry Run are grossly polluted due to acid mine discharges. The stream beds of these tributaries, as well as mainstem Licking Creek west of Sligo, Pennsylvania, are quite noticeably discolored due to the characteristic precipitation of iron compounds. The pH values of these tributaries ranged from 2.6 to 3.5 with conductivity values ranging from 1500 to 3250.

During the source investigation, 212 mine drainage sources were identified and sampled for chemical analysis. One hundred forty-one of these sources were discharging to watershed streams. The total measured discharge was 1095 gpm or 1.5 million gallons per day emanating from coal mine sources within the watershed. The

total measured source acid load from these discharging sources was 6302 lb/day. The sixteen principal watershed sources discharged an acid load of 4418 lb/day, 70 percent of the total source acid load. The largest acid load inventoried in the watershed was 667 lb/day from an abandoned gas well. The acidity concentration of this 12 gpm effluent was 4635 mg/l. Strip mines and underground mines or combinations of the two account for all but one of the sixteen principal watershed sources. The gas well discharge which carried the 667 lb/day acid load was the only well effluent located during the survey. Due to the extensive intermingling of both underground and surface mines and the numerous points of intersection, it was often difficult to determine the origin of the discharge point.

During a 1966 stream survey Licking Creek at mouth was consistently acid. The acidity concentration ranged from 294 mg/l to 395 mg/l while the pH value remained below 3.1.

Mine drainage loadings
by source type
Licking Creek watershed, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Hardness (lb/day)	Sulfate (lb/day)	Total Iron (lb/day)	Manganese (lb/day)
Strip mines (inactive)	106	587	2,656	5,469	8,412	261.9	157.4
Underground mines (inactive)	18	155	1,572	1,464	2,987	105.6	54.0
Combination Strip mines*	3	45	128	441	596	20.2	6.7
Gas Well (abandoned)	1	12	667	184	831	176.4	14.4
Combination Underground mines	2	274	1,252	2,245	4,007	190.4	43.5
Underground mine (active)	1	8	27	148	188	2.2	2.5
TOTALS	141	1,095	6,302	9,951	17,021	756.7	278.5

*Strip and underground mines together with principal portion of discharge from the strip mine.
**Underground and strip mines together with principal portion of discharge from the underground mine.

III. KISKIMINETAS RIVER TRIBUTARIES

Stony Creek, Pennsylvania
Little Conemaugh River, Pennsylvania
Conemaugh River, Pennsylvania
Blacklick Creek, Pennsylvania
Two Lick Creek, Pennsylvania
Loyalhanna Creek, Pennsylvania
Kiskiminetas River and Minor Tributaries, Pa.

Stony Creek Watershed, Pennsylvania

The headwaters of Stony Creek rise near Berlin, Pennsylvania, and flow generally north through Somerset and Cambria Counties to its confluence with the Little Conemaugh River at Johnstown, Pennsylvania. A total of 466 square miles are contained within this drainage area. The principal tributaries to Stony Creek are Quemahoning Creek and Shade Creek with drainage areas of 99 square miles each.

Stony Creek and its two principal tributaries are affected in varying degrees by coal mine discharges over nearly their entire lengths. Shade Creek is seriously degraded by discharges in its headwaters areas. Due to additional large discharges downstream, natural stream recovery becomes impossible and the acid conditions persist at its mouth.

Quemahoning Creek above Sipesville is unaffected by mine drainage. Below this point the creek receives numerous sources of pollutant discharges. Although Quemahoning is degraded by mine drainage it is probably the least affected portion of the watershed. A large privately-owned reservoir is located near the mouth of the creek which, after treatment, is used for industrial purposes.

The mainstem of Stony Creek is seriously degraded by mine drainage. This is particularly evident in the lower half of the watershed. Above Stoystown the water quality of Stony Creek improves rapidly. Although numerous discharge points are located above this point, the cumulative effect is limited to localized degraded water quality. The upper portion of the watershed contains several streams which support varied forms of aquatic life including stocked trout.

A total of 184 discharging sources were inventoried and sampled for chemical analysis in the Stony Creek watershed. The total measured discharge was 12,600 gpm or 18.1 million gallons per day emanating from coal mine sources. The total measured acid load was 41.5 tons per day. The largest single acid load was

13.1 tons per day from an abandoned drift mine. There were 10 additional sources which contributed acid loads exceeding 1000 lb/day. Abandoned underground mines are the principal acid contributing sources, approximately 80 percent of the total source load. Twelve of the numerous active mines inventoried had discharges at the time of inspection. The acid load contributed by these sources was 5513 lb/day.

Mine drainage loadings
by source type
Stony Creek watershed, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)
Drift mines (inactive)	112	9,254	66,372
Strip mine (inactive)	32	507	2,468
Combination drift mines (inactive)	16	839	3,362
Shaft mines (inactive)*	5	173	2,816
Combination Strip mines	5	56	421
Mine Refuse Areas (inactive)	1	3	900
Coal Crop	1	10	26
Drift mines (active)	7	1,461	5,954
Strip mines (active)	4	267	475
Coal Washery (active)	1	25	84
TOTALS	184	12,595	82,878

*Includes slope mines and borehole discharges.

Little Conemaugh River, Pennsylvania

The headwaters of the Little Conemaugh River rise near Cresson, Pennsylvania and flow generally west through Cambria County to its confluence with Stony Creek in the city of Johnstown, Pennsylvania. South Fork is the principal tributary to the Little Conemaugh River and drains 62 square miles of the total 188 square mile drainage area.

The headwaters of the river are affected by mine discharges immediately south of the community of Cresson. The discharge volume of these sources is small, however the effect upon the headwaters is a pH reduction to about 4.5 to 5.0. In the general area of Portage, Pennsylvania, the Little Conemaugh River receives massive amounts of mine drainage from abandoned shaft mine boreholes. Three such boreholes in this area discharged a measured flow of 5750 gpm and carried an acid load of 19 tons per day to the Little Conemaugh River. Trout Run, tributary to the Little Conemaugh, is a highly acid stream due to the borehole discharge of the Miller shaft mine. This discharge carried an acid load of 5.5 tons per day.

The water quality of the South Fork is unaffected by mine drainage above the community of Beaverdale. However, a borehole at Beaverdale results in continual downstream acid pollution of the South Fork. Below this point three additional major discharges were located. The largest of these resulted from the St. Michael shaft. At this point an acid load of 32.4 tons per day was discharged to the South Fork of the Little Conemaugh River.

During a 1966 stream sampling program, the Little Conemaugh River below the confluence of South Fork carried a maximum acid load of 55.5 tons per day.

Between the communities of South Fork and Johnstown numerous discharges contribute additional acid loads to the river. Several boreholes near Saltlick Reservoir and discharges on Clapboard Run carry high acid loads. The Little Conemaugh River was sampled and flow measurements obtained at the U. S. Geological Survey gaging station near the mouth of the river.

A total of 97 discharging sources were inventoried in the Little Conemaugh River drainage area. The total measured discharge volume was 20,383 gpm or 29.3 million gallons per day. The total source acid load was 135.5 tons per day. Active mines contributed only one to[illegible]per day of acidity.

Mine drainage loadings
by source type
Little Conemaugh River, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)
Drift mines (inactive)	42	3,238	19,776
Strip mines (inactive)	17	436	2,137
Shaft mines (inactive)	13	15,701	138,863
Combination Drift mines (inactive)	6	352	1,942
Mine Refuse Areas	14	262	6,351
Coal Crop	1	5	-1
Strip mine (active)	1	12	33
Drift mines (active)	3	377	1,716
TOTALS	97	20,383	170,817

Conemaugh River, Pennsylvania

The Conemaugh River is formed by the confluence of the Little Conemaugh River and Stony Creek at Johnstown, Pennsylvania. From this point the river flows northwest to its confluence with Loyalhanna Creek at Saltsburg, Pennsylvania. Due to the grossly polluted acid condition of both the Little Conemaugh River and Stony Creek, and additional acid discharges received by the mainstem, the Conemaugh River is severely polluted by coal mine drainage over its entire length.

Abandoned underground mines are the principal acid-contributing sources to the mainstem of the Conemaugh River. Twenty-four such discharging sites were examined. Their combined acid load was about 14 tons per day, approximately 75 percent of the total loading measured in this drainage area. The largest acid load encountered in the watershed was 8.8 tons per day from an abandoned underground mine draining directly to the river. There were five additional sources discharging acid loads in excess of 1,000 lb/day. Six refuse areas examined during the survey discharged a total of 3.3 tons per day of acidity.

A total of 35 discharging sources were sampled for chemical analysis along the mainstem Conemaugh River. The total measured discharge volume was 3,041 gpm, or 4.4 million gallons per day, emanating from coal mine sources. The total source acid load was 18 tons per day. Only one active mine was inventoried, however, its discharge was alkaline. Additional information remains to be obtained on discharges from several other active mining operations.

Mine drainage loadings
by source type
Main Stem of the Conemaugh River, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)
Draft mines (inactive)	24	2,727	27,786
Strip mines (inactive)	4	95	1,734
Combination Drift mines (inactive)	1	5	162
Mine Refuse Areas	6	214	6,578
TOTALS	35	3,041	36,260

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Blacklick Creek Watershed, Pennsylvania

Blacklick Creek (less Two Lick Creek, its principal tributary) drains 222 square miles of southern Indiana and central Cambria Counties, Pennsylvania. Its major tributaries are the North and South Branches which join near Vintondale, Pennsylvania to form Blacklick Creek. From Vintondale, the creek flows west to its confluence with the Conemaugh River near Blairsville, Pennsylvania.

Large active slope and shaft mine discharges, located on both the North and South Branches of Blacklick Creek, are primarily responsible for the severely degraded water quality of Blacklick Creek at Vintondale. The active mines located in this portion of the drainage area discharged over 17,000 gpm to watershed streams and carried an acid load exceeding 66 tons per day.

During the study period, refuse areas were found to be major sources of acid discharges. Twenty-five such sites were examined and sampled. The total acid load from these refuse areas was 28 tons per day. Near the community of Nanty Glo, a small tributary which is in continual contact with a large refuse pile, carried an acid load of 17.5 tons per day to the South Branch of Blacklick Creek.

Below Vintondale, significant acid loads are received by Blacklick Creek over its entire length. Inactive drift mines discharged an acidity loading of 30 tons per day and abandoned shaft mines contributed an additional 5.5 tons per day. Only two active mines discharged significant acid loads in this lower portion of the watershed.

A total of 160 discharging sources were inventoried in the Blacklick Creek drainage area (excluding Two Lick Creek). The total measured discharge volume was 25,230 gpm or 36.3 million gallons per day. The total source acid load was 136.5 tons per day. Active mines contributed approximately 50 percent of this total acid load.

During the 1966 stream survey, Blacklick Creek above Two Lick Creek carried an acidity loading which ranged from 0.17 to 1.2 million lb/day. The pH value remained below 3.0 during the sampling period. Acidity concentrations as high as 897 mg/l were recorded at this same point.

Mine drainage loadings
by source type
Blacklick Creek watershed, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)
Drift mines (inactive)	53	3,630	60,208
Strip mines (inactive)	39	1,109	2,004
Mine Refuse Areas	25	888	55,624
Combination Drift mines (inactive)	19	775	6,420
Combination Strip mines (inactive)	8	343	3,001
Shaft mines (inactive)	2	1,024	11,326
Shaft mines (active)*	9	16,730	130,748
Drift mines (active)	5	731	3,702
TOTALS	160	25,230	273,033

*Includes slope mines and borehole discharges.

Two Lick Creek Watershed, Pennsylvania

The headwaters of Two Lick Creek rise in east-central Indiana County, Pennsylvania, and flow southeast through the county to its confluence with Blacklick Creek near Blacklick, Pennsylvania. Yellow Creek is the principal tributary and drains 67 square miles of the total 190 square mile drainage area.

Two Lick Creek is formed by the junction of the North and South branches. The north branch is degraded by mine drainage in its headwaters area and, due to numerous downstream discharges, natural stream recovery is impossible. No evidence of mining activity was found on the South branch and its waters support numerous types of aquatic life.

Seven discharge points were found that carried acid loads exceeding 1,000 lb/day to Two Lick Creek. Six of these sources resulted from underground mines and one from a refuse pile. The highest acid load, four tons per day, resulted from an abandoned slope mine. During the mine drainage source investigation, stream sampling and attendant flow measurements were obtained at four points in the Two Lick Creek watershed.

Yellow Creek, principal tributary to Two Lick Creek, is unaffected by mine drainage above the Homer City water supply reservoir. Several minor discharge points were found above the reservoir; however, they cause no serious water quality problems and downstream stream recovery is rapid. A large mine dump from an active mine is located on the bank of Yellow Creek. Drainage from this dump and others in the immediate area are largely responsible for the noticeable discoloration of Yellow Creek. An acid load of 936 lb/day from a combination drift mine was the highest load encountered in the Yellow Creek drainage area.

A total of 174 discharging sources were inventoried and sampled for chemical analysis in the Two Lick Creek watershed. The total measured discharge volume was 7,143 gpm or 10.3 million gallons per day. The total source acid load was 17.3 tons per day. Active mines inventoried during the survey contributed a daily acidity loading of 501 lb/day.

Mine drainage loadings
by source type
Two Lick Creek watershed, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)
Drift mines (inactive)	73	4,421	12,362
Strip mines (inactive)	44	786	2,605
Mine Refuse Areas	20	298	7,318
Shaft Mines* (inactive)	2	350	8,117
Combination Drift mines (inactive)	16	502	2,613
Combination Strip mines (inactive)	12	213	1,087
Gas Wells (abandoned)	2	22	11
Drift mines (active)	5	551	501
TOTALS	174	7,143	34,614

*Includes slope mines and borehole discharges.

Loyalhanna Creek Watershed, Pennsylvania

Loyalhanna Creek drains a 300 square mile drainage area in Westmoreland County, Pennsylvania. The creek flows northwest through the county and at Saltsburg, Pennsylvania joins the Conemaugh River to form the Kiskiminetas River. Latrobe is the principal community in the watershed and is located near the mid-point of the length of Loyalhanna Creek.

Above Labtrobe, the Loyalhanna Creek watershed receives numerous acid mine discharges. However, these discharges are highly localized and downstream recovery is rapid. Recovery is apparent in the area around Wilpen, Pennsylvania. Above Latrobe, Loyalhanna Creek and many of its tributaries support an abundance of aquatic life including game fish such as trout and bass.

Drainage from the abandoned St. Vincent Shaft Mine completely depletes the remaining in-stream alkalinity of Loyalhanna Creek. In downtown Latrobe, a 1990 gpm discharge from the St. Vincent Mine is piped to Loyalhanna Creek. There is no stream recovery below this point. The acid load carried by this discharge was 8.5 tons per day. Two additional major discharge points were inventoried downstream of this point. Near the mouth of Saxmon Run, a common drainway to numerous interconnected mines, carried an acid load of 6.2 tons per day to Loyalhanna Creek. The largest acid load encountered in the Loyalhanna watershed was 10 tons per day from a 5100 gpm discharge at Crabtree, Pennsylvania.

During the 1968 source investigation, 50 discharging sources were inventoried and sampled for chemical analysis. The total measured discharge was 10,885 gpm or 15.6 million gallons per day emanating from coal mine sources within the watershed. The total source acid load was 30.5 tons per day. The three sources mentioned above contribute 86 percent of the total measured discharge volume and 80 percent of the total acid load. There were no inventoried discharges from active mines at the time of the source investigation.

Data from a 1966 stream survey showed Loyalhanna Creek, at the mouth, to be consistently acid. The acid load carried near the mouth ranged from 17 tons per day to a maximum of 154 tons per day during differing hydrologic periods. The pH value remained below

4.8 during the sampling period. Additional stream sampling was conducted at this same point during the mine drainage source investigation, however, compilation of this data is not complete at this writing.

Mine drainage loadings
by source type
Loyalhanna Creek watershed, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)
Drift mines (inactive)	21	5,618	24,741
Shaft mines (inactive)	8	4,551	32,309
Strip mines (inactive)	7	221	938
Combination Drift mines (inactive)	7	310	465
Mine Refuse areas	4	156	2,850
Combination Strip mines (inactive)	2	26	123
Coal Crop Seep	1	3	33
TOTALS	50	10,885	61,459

Kiskiminetas River and Minor Tributaries, Pennsylvania

The Kiskiminetas River is formed by the junction of Loyalhanna Creek and the Conemaugh River at Saltsburg, Pennsylvania. From this point the river flows northwest through the communities of Apollo, Vandergrift, and Leechburg, Pennsylvania, to its confluence with the Allegheny River at Schenley, Pennsylvania. The mainstem Kiskiminetas River drains an area of 216 square miles.

Due to the grossly polluted acid condition of both Loyalhanna Creek and the Conemaugh River, the Kiskiminetas River exhibits similar acid conditions over its entire length. Particularly in the Saltsburg area, the river carries the characteristic iron discoloration of mine drainage waters. The river bed and high water levels are heavily stained and coated with precipitated iron compounds. Alkaline tributary inflow entering the river below Saltsburg is immediately assimilated with no noticeable water quality improvement to the mainstem.

During the 1968 source investigation, 64 discharging mine sources were identified and sampled for chemical analysis. The total measured discharge was 1953 gallons per minute, or 2.8 million gallons per day, emanating from coal mine sources within the drainage area. The total source acid load was 53,132 lb/day. Abandoned underground mines and refuse areas were the principal acid contributing sources. One very large and still active refuse pile near Brownstown, Pennsylvania, contributed almost 11 tons per day of acidity, 40 percent of the total source acid load. The acidity concentration for one of the four samples collected at this site exceeded 34,000 mg/l. The largest acid load from an underground mine was 6435 lb/day from a discharge located at the Brownstown mining complex. Active mines inventoried during the survey period contributed 3365 lb/day of acidity to the Kiskiminetas River.

During a 1966 stream survey the Kiskiminetas River carried an acid load ranging from 0.6 to 1.2 million pounds per day. The acidity and iron concentrations ranged from 159 to 259 mg/l and 5.5 to 33 mg/l respectively. The pH value remained below 3.7 during the sampling period.

Mine drainage loadings
by source type
Kiskiminetas River - mainstem and tributaries, Pa.

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)
Strip mines (inactive)	12	85	1,337
Drift mines (inactive)	26	964	19,269
Combination Drift mines (inactive)	14	383	6,470
Combination Strip mines (inactive)	1	3	23
Mine Refuse areas (abandoned)	8	110	22,601
Oil Wells (abandoned)	1	7	67
Drift mines (active)	2	401	3,3o5
TOTALS	64	1953	53,132

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IV. MONONGAHELA RIVER TRIBUTARIES

Lower Monongahela River and minor tributaries, Pa.
Redstone Creek and Dunlap Creek, Pennsylvania
Tenmile Creek, Pennsylvania
Middle Monongahela River and minor tributaries, Pa.
Dunkard Creek, Pennsylvania-West Virginia
Upper Monongahela River and minor tributaries, Pa.-W.Va.
Buffalo Creek and Paw Paw Creek, West Virginia
Lower West Fork River, West Virginia
Tenmile Creek, West Virginia
Elk Creek, West Virginia
Upper West Fork River, West Virginia
Lower Tygart Valley River, West Virginia
Middle Tygart Valley River, West Virginia
Buckhannon River, West Virginia
Middle Fork River, West Virginia
Upper Tygart Valley River, West Virginia
Lower Cheat River, Pennsylvania-West Virginia
Big Sandy Creek, Pa. - W. Va. - Md.
Upper Cheat River, West Virginia
Shavers Fork, West Virginia
Black Fork-Blackwater River, West Virginia
Lower Youghiogheny River, Pennsylvania
Sewickley Creek, Pennsylvania
Middle Youghiogheny River, Pennsylvania
Mounts Creek and Indian Creek, Pennsylvania
Youghiogheny River West, Pennsylvania
Laurel Hill Creek, Pennsylvania
Casselman River, Pennsylvania-Maryland
Upper Youghiogheny River, W. Va. - Pa. - Md.

Lower Monongahela River Watershed, Pa.

This 323 square mile area is located just south of Pittsburgh, Pennsylvania. The Pittsburgh area was the site of the first commercial coal mines in the Monongahela River basin.

Over 173 miles of streams are affected by mine drainage in this drainage area. Water quality data for the Monongahela River at Charleroi, Pennsylvania was developed during the mine drainage study. The average pH of the 37 samples taken was 4.2 and the values ranged from 3.3 to 5.6. Ranges of concentrations of the various parameters were: alkalinity, 0 to 6 mg/l; acidity, 6 to 141 mg/l; iron, 0.0 to 4.5 mg/l; and sulfate, 55 to 500 mg/l.

There were 232 discharging mines in the area at the time of inventory. A total of 3,058 acres were disturbed by surface mines. The total discharge from all mines was 16,186 gpm resulting in a net acidity load of 24.6 tons per day and an iron load of 9.7 tons per day.

There were 15 active operations within the study area. Their discharges comprised 38 percent of the total mine discharge volume and carried 70 percent of the total iron load and 72 percent of the total acidity loading measured in the Lower Monongahela River basin.

Mine drainage loadings
by source type
Lower Monongahela River, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Preparation Plants (active)	3	87	56	7
Shaft mines (active)	2	4009	35,465	12,481
Shaft mines (inactive)	1	47	-207	4
Strip mines (active)	-	-	-	-
Strip mines (inactive)	35	1597	3947	318
Drift mines (active)	8	2043	-156	979
Drift mines (inactive)	149	7663	8853	5419
Strip and Drift mines combined (active)	2	64	36	18
Strip and Drift mines combined (inactive)	32	676	1223	81
TOTALS	232	16,186	49,217	19,307

Redstone Creek and Dunlap Creek Watersheds, Pa.

Redstone Creek and Dunlap Creek drain 112 and 43 square miles, respectively. Both areas are located just northwest of Uniontown, Pennsylvania.

Mine drainage sources are scattered along the entire length of each watershed. Over 99 miles of these streams are affected by mine drainage. Water quality in Redstone Creek was monitored at Grindstone, Pennsylvania. Average pH for the fifteen samples taken was 5.4, with the minimum being 3.2 and the maximum, 6.6. Ranges for other parameters were: alkalinity, 0 to 334 mg/l; total acidity, 0 to 734 mg/l; sulfate, 229 to 2320 mg/l; and iron, 2.4 to 51.5 mg/l.

Sixteen mines were found to be draining in the study area. Surface mining had disturbed 1,174 acres. Total flow from all mines was 1,639 gpm carrying 21,169 pounds per day net acidity and 18,382 pounds per day of iron.

Three active mines produced 4 percent of the total flow, 9 percent of the total net acidity and 2 percent of the total iron.

Seven principal mine drainage sources discharged 92 percent of the total acidity loading from all mine effluents inventoried.

Mine drainage loadings
by source type
Redstone Creek and Dunlap Creek, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Shaft mines (inactive)	3	1523	19,342	18,096
Strip mines (active)	3	72	1,857	284
Strip mines (inactive)	3	4	-4	0
Drift mines (inactive)	4	14	-3	2
Strip and Drift mines combined (inactive)	3	26	-23	0
TOTALS	16	1639	21,169	18,382

Ten Mile Creek Watershed, Pennsylvania

This 338 square mile watershed is located in the northwest part of the Monongahela River basin. Approximately 81 miles of streams in the watershed are affected by coal mine drainage.

There were no strip mines among the 44 discharging mines inventoried. The total flow from these mines was 4,080 gpm, or 5.7 million gallons per day. The total source acid load was 16,723 pounds per day. In addition, an iron load of 7,658 pounds per day was discharged to the streams within the study area.

The principal sources of acid pollution in the study area are active shaft mines. They discharged 24 percent of the total mine discharge volume, 94 percent of the total acid load, and 62 percent of the total iron loading. Nearly the entire remaining basin loadings of acidity and iron are discharged by 6 additional active drift mines. Abandoned drift mines inventoried during the study contributed a net alkalinity of 7 lb/day.

Mine drainage loadings
by source type
Ten Mile Creek (including South Fork), Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Shaft mines (active)	2	938	15,703	4,621
Drift mines (active)	6	2,722	1,027	2,978
Drift mines (inactive)	36	420	-7	59
TOTALS	44	4,080	16,723	7,658

Middle Monongahela River Watershed, Pennsylvania

This 271 square mile area is located in the immediate area of the community of Masontown, Pennsylvania. Major tributaries to the main stream in this reach include Whitely Creek, draining 56 square miles, and Georges Creek, draining 67 square miles.

Mine drainage affects some 200 miles of streams in this study area. Water quality in this area was monitored at Greensboro, Pennsylvania, on the Monongahela River in the vicinity of Whitely Creek and Georges Creek. The average pH of fifteen samples from the Monongahela River was 4.1. The pH range was from 2.9 to 6.5. Ranges of other parameters were: alkalinity, 0 to 9 mg/l; acidity, 28 to 226 mg/l; sulfate, 54 to 1460 mg/l; and iron, 0.7 to 57.2 mg/l. The average pH of the seventeen samples from Whitely Creek was 4.8. Georges Creek had an average pH of 3.5 from twelve samples.

A total of 104 mine discharges were inventoried totalling 8,739 gpm flow to receiving streams. The total acidity loading from these effluents was 49,955 lb/day and the total iron loading was 14,502 lb/day.

Twenty three active operations in this watershed produced 73 percent of the total mine discharge volume measured, 26 percent of the total acidity discharged, and 62 percent of the total iron loading discharged to receiving streams.

Discharges from 18 principal mine drainage sources contributed 75 percent of the total watershed acid loading discharging to receiving streams at the time of the inventory.

Mine drainage loadings
by source type
Middle Monongahela River, Pennsylvania-West Virginia

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Preparation Plants (active)	6	300	2,066	382
Shaft mines (active)	4	3,169	-28,970	2,657
Shaft mines (inactive)	3	132	-1,204	8
Strip mines (active)	1	20	541	89
Strip mines (inactive)	16	742	14,290	735
Drift mines (active)	3	420	7,539	2,119
Drift mines (inactive)	39	855	3,702	1,175
Strip and Drift mines combined (active)	9	2,482	31,757	3,677
Strip and Drift mines combined (inactive)	23	619	20,234	3,660
TOTALS	104	8,739	49,955	14,502

Dunkard Creek Watershed, W. Va. - Pa.

The Dunkard Creek watershed drains 239 square miles, 107 in West Virginia and 132 in Pennsylvania. Most of the coal mining is restricted to the Pittsburgh and Sewickley seams.

Water quality in the Dunkard Creek watershed is good with only a very small portion of the basin affected by mine drainage pollution. Water quality in the upper end of the watershed is affected by effluent from several oil and gas wells.

A total of 121 mine sites were investigated, 88 underground sites and 33 surface sites. Of these, 10 underground mines and one strip operation were active at the time of inspection. Samples were collected from 30 drainage sources, 28 of which were discharging at the time of the survey. Discharges from coal mine sources ranged from 0 to 1241 gallons per minute and totalled 2.3 million gallons per day. It is estimated that an additional 9 million gallons per day are discharged outside the basin through pumping from operating underground mines. Acidity concentrations from 5 milligrams per liter (mg/l) to 6518 mg/l were found in the mine effluents.

Discharges from two principal mine drainage sources were found to contribute 87 percent of the total watershed acid loading discharging to receiving streams at the time of the study.

Mine drainage loadings
by source type
Dunkard Creek, West Virginia-Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Drift mines (active)	5	119	3,364	933
Drift mines (inactive)	17	236	5,924	925
Shaft mines (active)	1	1,241	42,637	8,798
Strip mines (inactive)	5	20	624	159
TOTALS	28	1,616	52,549	10,815

Upper Monongahela River Watershed, W.Va. - Pa.

The center of this 300 square mile sub-basin is near Morgantown, West Virginia. The major tributary is Deckers Creek, draining 63 square miles east of Morgantown.

Mine drainage affects over 180 miles of streams, including the entire mainstem of the Monongahela in this area and most tributaries to the main stream.

Surface mining has left an estimated 2800 disturbed acres of land within this area. The total discharge from 185 inventoried mine drainage sources in this study area was 8,935 gpm. This discharge volume carried a total acidity loading of 181,547 pounds per day and a total iron loading of 40,113 pounds per day to receiving streams.

Twenty-five active mining operations produced 65 percent of the total mine discharge volume, 69 percent of the total coal mine acidity, and 29 percent of the total iron loading discharged to receiving streams.

Twelve principal mine drainage sources discharged 86 percent of the total acidity loading from all mine effluents inventoried.

Mine drainage loadings
by source type
Upper Monongahela River, West Virginia

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Preparation Plants (active)	4	364	-22	131
Shaft mines (active)	1	373	6,918	2,438
Shaft mines (inactive)	-	-	-	-
Strip mines (active)	3	57	1,035	96
Strip mines (inactive)	44	674	13,763	1,760
Drift mines (active)	16	5,030	117,250	26,130
Drift mines (inactive)	89	2,039	29,581	5,244
Strip and Drift mines combined (active)	1	8	729	147
Strip and Drift mines combined (inactive)	27	390	12,293	4,167
TOTALS	185	8,935	181,547	40,113

Buffalo Creek and Paw Paw Creek, W. Va.

The Buffalo Creek and Paw Paw Creek watersheds drain a combined area of 177 square miles in the west-central portion of the Monongahela basin.

Some 53 mine sites and an estimated 4.1 acres of surface mined area were investigated during the mine drainage inventory. Samples were collected from 13 drainage sources, 11 of which were discharging at the time of the survey. Discharges from the coal mine sources totalled 1.3 million gallons per day. Acidity concentrations of 35 mg/l to 2300 mg/l were found in the mine effluents.

Five active mining operations and one active preparation plant were examined during the course of the field study. These active mining operations contributed 70 percent of the total effluent volume, 72 percent of the total acidity loading, and 73 percent of the total iron loading. Inactive or abandoned underground mines contributed the remainder of the pollution from mine drainage.

Discharges from two principal mine drainage sources contributed 98 percent of the total watershed acid loading entering receiving streams at the time of the study.

Mine drainage loadings
by source type
Buffalo Creek and Paw Paw Creek, West Virginia

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Preparation Plants (active)	3	123	4	55
Shaft mines (active)	6	1,642	6,723	2,624
Drift mines (inactive)	2	2	13	2
TOTALS	11	1,767	6,740	2,681

Lower West Fork Watershed, West Virginia

The Lower West Fork watershed drains 256 square miles of west-central West Virginia north of Clarksburg, West Virginia.

The water quality of the Lower West Fork watershed is seriously degraded by mine drainage over nearly two-thirds of the total stream length by mine drainage.

Some 404 mine sites and an estimated 3700 acres of strip-mined area were investigated during this study. Samples were collected from 421 drainage sources, 396 of which were discharging at the time of the survey. Discharges from the coal mine sources totalled 30.1 million gallons per day. Acidity concentrations from 0 mg/l to 4840 mg/l were found in the mine effluents.

Twenty-four active mining operations were examined during the course of the field study. Active mining operations contributed about 20 percent of the total discharge volume measured and about 20 percent of the chemical loadings being discharged to receiving streams. Inactive or abandoned strip and underground (drift) mines are the principal mine drainage pollution sources in the Lower West Fork River watershed.

Discharges from fifty-three principal mine drainage sources contributed 85 percent of the total watershed acid loading discharged to receiving streams at the time of the study.

Mine drainage loadings
by source type
Lower West Fork River, Pennsylvania, West Virginia

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Preparation Plants (active)	3	146	403	274
Preparation Plants (inactive)	1	3	22	7
Shaft mines (active)	2	746	15	164
Shaft mines (inactive)	1	273	0	48
Strip mines (inactive)	127	3,087	25,051	7,127
Drift mines (active)	19	3,242	40,917	8,958
Drift mines (inactive)	227	12,764	131,723	31,286
Strip and Drift mines (inactive) (combined)	16	643	4,531	1,063
TOTALS	396	20,904	202,662	48,927

Tenmile Creek Watershed, W. Va.

The Tenmile Creek (West Virginia) watershed drains 128 square miles in the west-central portion of the Monongahela basin.

Some 107 mine sites, an estimated 881 acres of surface mined area, and 56 acres of gob area were investigated during this study. Samples were collected from 66 drainage sources, 60 of which were discharging at the time of the survey. Discharges from the coal mine sources totalled 2.05 million gallons per day. Acidity concentrations from 0 mg/l to 4070 mg/l were found in the mine discharges.

Seven active mining operations were examined during the course of the field study. Active mining operations contributed 27 percent of the total discharge volume, 2.3 percent of the total coal mine acidity loading, and 22.4 percent of the total iron loadings.

Discharges from thirteen principal mine drainage sources contributed 86 percent of the total watershed acid loading entering receiving streams at the time of the study.

Mine drainage loadings
by source type
Tenmile Creek, West Virginia

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Drift mine (active)	5	255	422	290
Drift mine (inactive)	30	411	6,166	2,207
Strip mine (inactive)	23	592	383	267
Strip and Drift mines Combined (inactive)	1	33	-20	14
Shaft mines (active)	1	130	-267	430
TOTALS	60	1,421	6,684	3,208

Elk Creek Watershed, West Virginia

The Elk Creek watershed drains 123 square miles of southwestern West Virginia, near Clarksburg, West Virginia.

The water quality of Elk Creek is seriously degraded over nearly its entire length as a result of coal mine drainage. Two belts of mining activity cross the area, one near the mouth of Elk Creek, and the other across the middle of the basin's length.

Some 217 mine sites and an estimated 3000 acres of strip-mined area were investigated during this study. Samples were collected from 119 sources, 106 of which were discharging at the time of the survey. Discharges from the drainage sources totalled 6.2 million gallons per day. The mine discharges consistently carried high hardness, sulfate and iron loadings.

Nineteen active mining operations were examined during the course of the field study. Active mining operations contributed significantly to the percentage of the total discharge volume and chemical loadings measured. Sixteen active mines produced 23 percent of the total mine discharge volume, 31 percent of the total acidity loadings, and 17 percent of the total iron loading.

Inactive or abandoned strip, auger, and underground mines (drift) contributed the major portion of the total pollution loading in the Elk Creek watershed.

Discharges from fifteen principal mine drainage sources contributed 86 percent of the total watershed loading entering receiving streams at the time of the study.

Mine drainage loadings
by source type
Elk Creek, West Virginia

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Drift mines (active)	9	501	8,165	149
Drift mines (inactive)	46	1,576	18,495	4,621
Strip mines (active)	4	26	17	31
Strip mines (inactive)	22	627	3,101	535
Strip & Auger mines combined (active)	4	469	4,922	1,158
Strip & Auger mines combined (inactive)	16	1,021	5,718	1,362
Strip & Drift mines combined (inactive)	6	121	645	209
TOTALS	106	4,341	41,063	8,065

Upper West Fork River, West Virginia

The Upper West Fork River watershed drains 395 miles of southwestern West Virginia.

The water quality of the Upper West Fork is severely polluted over three-fourths of its length. Only the headwaters in the southern and western section of the basin are relatively free of mine drainage.

Some 233 mine sites and an estimated 3700 acres of strip-mined area were investigated during this study. Samples were collected from 214 sources, 194 of which were discharging at the time of the survey. Discharges from the coal mine sources totalled 3.2 million gallons per day. Acidity concentrations ranging from 0 mg/l to 5465 mg/l were found in the mine effluents.

Twenty-three active mining operations were examined during the course of the field study. The active mines contributed only a small percentage of the total mine discharge volume, however, they contributed over 50 percent of the total acidity and iron loadings discharged in the watershed.

Discharges from twenty-five principal mine drainage sources contributed 35 percent of the total watershed acid loading being discharged to the receiving streams at the time of the study.

Mine drainage loadings
by source type
Upper West Fork River, West Virginia

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Drift mines (active)	3	52	607	79
Drift mines (inactive)	78	790	2,161	543
Strip mines (active)	1	1	6	1
Strip mines (inactive)	87	835	1,095	152
Auger mines (active)	3	84	3,850	1,105
Auger mines (inactive)	1	2	1	1
Strip & Auger mines (active) combined	1	30	-21	5
Strip & Auger mines (inactive) combined	10	187	569	94
Strip & Drift mines (inactive) combined	8	216	279	104
Refuse Areas (inactive)	1	4	18	2
Strip & Drift mines (active) combined	1	1	4	0
TOTALS	194	2,202	8,569	2,086

Lower Tygart Valley River Watershed, West Virginia

For purposes of the source investigation, the Tygart Valley River basin was divided into several sub-basins. The Lower Tygart is defined as that portion of the river from its confluence with the West Fork River at Fairmont, West Virginia, upstream to the Tygart Valley River Reservoir. A total of 196 square miles is contained within this drainage area.

There are two major areas of mining activity. These are located in the southwestern corner and along the entire eastern portion of the basin. Lost Run and Otter Run in the southwestern portion, and Threefold Creek and its tributaries in the eastern portion of the basin, represent the two areas most seriously affected by coal mine drainage.

A total of 286 mines were inventoried in the Lower Tygart Valley River sub-basin. Of these, 174 were drift mines and 112 were strip mines. Abandoned drift mines were the principal acid contributing sources, discharging almost 14 tons per day of acidity composing about 50 percent of the sub-basin load. One hundred and seventy mines were discharging at the time of the source inventory. The total measured discharge was 6028 gpm or 8.7 million gallons per day emanating from coal mine sources. The total net acid load received by basin streams was over 28 tons per day. In addition, almost six tons per day of iron was discharged in the study area. There were 29 mines and one preparation plant in operation at the time of inventory which contributed over 7.5 tons per day of acidity.

Mine drainage loadings
by source type
Lower Tygart Valley River, Pennsylvania-West Virginia

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Preparation Plants (active)	1	13	230	54
Strip mines (active)	2	288	2,126	326
Strip mines (inactive)	48	1,271	6,364	1,524
Drift mines (active)	11	357	5,305	1,126
Drift mines (inactive)	88	2,194	27,933	7,031
Strip and Drift mines combined (active)	3	1,246	8,064	871
Strip and Drift mines combined (inactive)	17	659	6,289	800
TOTALS	170	6,028	56,311	11,732

Middle Tygart Valley River Watershed, W. Va.

The Middle Tygart Valley River watershed drains 320 square miles of central West Virginia. Both surface and underground mining has occurred in the area with drift mines being the most numerous type of operation.

Water quality data from the Middle Tygart Valley River area shows that none of the major tributaries are free from mine drainage. The water quality effects of mine drainage over the basin are generally those of excessive concentrations of iron, sulfate, hardness, and total mineralization in the streams.

Some 308 mines and an estimated 725 acres affected by surface mining were inspected during the study. Samples were collected from 137 drainage sources. Discharges from the coal mine sources ranged from 1 to 168 gpm and totalled 2.4 million gallons per day. The pH values ranged from 3.3 to 5.4 and total acidity concentrations from 0 mg/l to 5,350 mg/l were found.

Ten active mining operations were examined during the course of the field study. Active mining operations contributed only a small percentage of the total discharge and chemical loadings measured. Inactive strip and drift mines, and one inactive preparation plant are the principal mine drainage pollution source types in this watershed.

Discharges from eleven principal mine drainage sources contributed 85 percent of the total watershed acid loading being discharged to receiving streams at the time of the study.

Mine drainage loadings
by source type
Middle Tygart Valley River, West Virginia

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Strip mines (active)	2	6	11	1
Strip mines (inactive)	29	454	1,836	175
Drift mines (active)	2	81	328	34
Drift mines (inactive)	98	791	4,213	702
Strip and Drift mines combined (inactive)	5	175	854	93
Preparation plants (inactive)	1	168	2,772	649
TOTALS	137	1,675	10,014	1,654

Buckhannon River Watershed, West Virginia

The Buckhannon River watershed drains 320 square miles of the southwestern portion of the Monongahela River basin of West Virginia. It has been mined since the 1800's for a variety of coals by both underground and surface mining methods.

The water quality of the Buckhannon River is degraded over nearly its entire length as a result of coal mine drainage. A portion of nearly every tributary to the main stream is affected by mine discharges. Precipitation of iron compounds has occurred in some tributaries.

The field investigation tallied 22 active mines, 1,828 acres disturbed by surface mining, 358 inactive drift mines, 110 acres of refuse and 75 acres affected by mine subsidence. Discharges from the coal mine sources amounted to 6.4 million gallons per day from 245 measured discharges.

Discharges from seven principal mine drainage sources contributed 92 percent of the total watershed acid loading entering receiving streams at the time of the study.

Mine drainage loadings
by source type
Buckhannon River, West Virginia

Source Type	No.	Total Discharge (gpm)	Net Acidity (lb/day)	Total Iron (lb/day)
Drift mines (active)	10	1,485	-1,151	425
Drift mines (inactive)	186	1,072	1,920	399
Strip mines (active)	1	10	7	0
Strip mines (inactive)	21	657	735	86
Strip and Drift mines (inactive) combined	22	1,063	244	35
Mine Refuse areas	1	7	292	56
Auger mines (active)	3	174	941	174
Auger mines (inactive)	1	5	2	0
TOTALS	245	4,473	2,990	1,175

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Middle Fork River Watershed, West Virginia

The Middle Fork River is a tributary to the Tygart River Valley in north-central West Virginia. It drains an area of 156 square miles and is approximately 38 miles in length. The principal portion of the basin lies in western Randolph County with remaining small portions in Upshur and Barbour Counties.

Mining operations in this rivers basin are absent above the community of West Huttonsville. The portion of the basin below West Huttonsville and the confluence of Long Run with the Middle Fork River contains nearly all the mining activity located in the river basin. Underground mining methods predominate throughout the basin, particularly along both banks of Long Run.

During the field investigations, a total of 67 discharging mines were inventoried and sampled for chemical analysis. The total discharge volume was 986 gpm or 1.4 million gallons per day. The total source acid load was 1028 lb/day. Abandoned strip mines were the principal acid contributing sources, discharging 85 percent of the total acid load. The 52 abandoned drift mines contributed only 58 lb/day of acidity. Active drift mines in the basin contributed a net alkalinity of 12 lb/day.

The water quality of the Middle Fork River above Cassity is not seriously affected by coal mine drainage. Below this point the river receives varying amounts of acid mine drainage which is responsible for the degraded water quality found at the mouth of the Middle Fork River. During the source inventory thirty-two samples and flow measurements were obtained at the U. S. Geological Survey gaging station located at Adolph near the mouth of the Middle Fork River. On all but two occasions acidity concentrations exceeded alkalinity concentrations at this point. The average alkalinity load was 2123 lb/day while the acidity load averaged 7,702 lb/day, giving an average net acidity load of 5579 lb/day.

Mine drainage loadings
by source type
Middle Fork River, West Virginia

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Drift mines (active)	5	42	-12	1
Drift mines (inactive)	52	331	58	5
Strip mines (inactive)	7	438	877	106
Strip and Drift mines (inactive) combined	3	175	105	17
TOTALS	67	986	1,028	129

Upper Tygart Valley River Watershed, West Virginia

For purposes of the mine drainage inventory, the Tygart Valley River was divided into several sub-basin areas. The Upper Tygart Valley River, which this report is concerned with, is defined as that portion of the basin from the headwaters, near the community of Valley Head, to the downstream community of Belington, a distance of about 75 miles. Nearly all of this 355 square mile drainage area is located in Randolph County. Minor portions of the watershed are contained in Pocahontas and Barbour Counties.

Mining operations in the Upper Tygart Valley River basin are been limited to the Roaring Creek and Grassy Run watersheds the area immediately south of the community of Belington. The water quality of the Upper Tygart Valley River is unaffected by coal mine drainage above this area.

Exclusive of the Roaring Creek and Grassy Run areas, abandoned drift mines and combination drift mines are the principal acid contributing sources. Combination drift and strip mines include those areas which have been drift-mined and later strip-mined or areas where drift mine openings have been located in the highwall after completion of strip mining. Twenty-seven discharging drift mines contributed an acid load of 10,188 lb/day in this drainage area. An additional acid load of 9245 lb/day was discharged to the watershed by combination drift and strip mines. The remaining portion of the acid load is contributed by inactive strip mines and auger mines, some 6200 lb/day.

A total of 59 discharging sources were inventoried and sampled for chemical analysis. The total measured discharge was 4394 gpm or 6.3 million gallons per day emanating from coal mine sources within the basin. The total source acid load was 25,693 lb/day. Two discharging active mines inventoried during the survey contributed an acid load of only 56 lb/day.

Since 1964 an acid mine drainage demonstration project has been in operation on the Roaring Creek and Grassy Run watersheds. There are 18 individual drift mines in this area and over 600 openings. Most of these openings represent points of intersection resulting from strip operations which broke through into the underground workings. Acid loads approaching 40 tons per day were

attributable to discharges located within this highly interconnected mining complex. The study was undertaken in an attempt to study the effect upon the water quality of the receiving stream by surface water diversion away from the underground mine voids and reclamation of the disturbed surface area. Since initiation of the project over twelve square miles of surface area have been reclaimed. In addition both wet and dry seals have been constructed. Since completion of the construction program in November 1967, the effectiveness of this reclamation program in reducing acid pollution is being evaluated through a program of water sampling and analysis.

Mine drainage loadings
by source type
Upper Tygart Valley River, West Virginia

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Drift mines (active)	1	30	56	2
Drift mines (inactive)	27	1,446	10,188	640
Strip mines (active)	1	3	0	0
Strip mines (inactive)	18	1,408	3,948	239
Strip and Drift mines (inactive) combined	9	1,175	9,245	112
Auger mines (inactive)	2	244	2,172	80
Strip and Auger mines (inactive) combined	1	88	84	12
TOTALS	59	4,394	25,693	1,085

Lower Cheat River Watershed, W. Va. - Pa.

This 386 square mile area extends from near the Maryland-West Virginia border to just north of the West Virginia-Pennsylvania state line. Lake Lynn, which is located near the mouth of the Cheat River, is included in this area.

Mine drainage affects 144 miles of streams in this drainage area. The average pH of 13 samples taken from just below Lake Lynn was 4.2. The pH range was 3.2 to 6.7. Ranges of other mine drainage related parameters were: alkalinity, 0 to 11 mg/l; acidity, 4 to 158 mg/l; sulfate, 16 to 222 mg/l; and iron, 0.1 to 11.0 mg/l.

Surface mining has disturbed 3,822 acres. The 146 operations inventoried had a total discharge of 6,375 gpm. This carried a total net acidity of 64.7 tons per day and a total iron load of 12.8 tons per day.

The 24 active operations produced 16 percent of the flow, 22 percent of the total net acid load, and 22 percent of the total iron load.

The principal sources of acid pollution in the watershed are abandoned drift mines and abandoned combination underground strip mines. The total net acid load from these sources was 49.5 tons per day. This accounts for approximately 77 percent of the total mine discharge acidity measured in the Lower Cheat River watershed.

Mine drainage loadings
by source type
Lower Cheat River, West Virginia-Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Drift mines (active)	16	309	5,797	1,499
Drift mines (inactive)	72	4,030	57,200	11,752
Strip mines (active)	3	218	4,751	918
Strip mines (inactive)	27	178	2,278	523
Strip and Drift mines combined (active)	5	504	17,368	3,244
Strip and Drift mines combined (inactive)	20	1,090	41,773	7,581
Strip and Auger mines combined (inactive)	3	46	276	46
TOTALS	146	6,375	129,443	25,563

Big Sandy Creek Watershed, W. Va. - Pa. - Md.

The Big Sandy Creek Watershed drains 212 square miles of northern West Virginia and is a tributary of the Cheat River.

The water quality of Big Sandy Creek is affected by mine drainage over about one-third of the watershed area with approximately 70 miles of streams affected. The area north of the community of Brandonville is not affected by mine drainage.

Some 33 mine sites and an estimated 2,197 acres of strip mined area were investigated during this study. Samples were collected from 47 drainage sources, 39 of which were discharging at the time of the survey. Discharges from the coal mine sources totalled 0.57 million gallons per day. Acidity values as high as 3105 mg/l were found in the mine effluents.

Five active mining operations were examined during the course of the field study. Active mining operations contributed about 23 percent of the total volume, 40 percent of the total acidity loading, and 55 percent of the total iron loading. Inactive or abandoned strip and underground (drift) mines discharged the remainder of the mine drainage pollution in the Big Sandy Creek Watershed.

Discharges from eleven principal mine drainage sources contributed 86 percent of the total watershed acid loading discharged to receiving streams at the time of the study.

Mine drainage loadings
by source type
Big Sandy Creek, West Virginia
Pennsylvania, Maryland

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Strip mine (inactive)	17	199	793	68
Strip mine (active)	1	84	690	117
Drift mine (active)	1	8	67	14
Drift mine (inactive)	15	65	223	31
Strip and Drift mines combined (inactive)	5	39	88	7
TOTALS	39	395	1,861	237

Upper Cheat River Watershed, W. Va.

The Upper Cheat River watershed drains 337 square miles of southeastern West Virginia.

Mine drainage effects are most pronounced in the watershed area downstream of the community of Rowlesburg. Over 30 miles of streams are affected by mine drainage in this watershed.

Some 213 mine sites and an estimated 1132 acres of surface mined area were investigated during this study. Samples were collected from 110 drainage sources, 95 of which were discharging at the time of the survey. Discharges from coal mine sources totalled 8.7 million gallons per day. The acidity concentrations ranged up to 8312 mg/l in mine effluents.

Thirty-three active mining operations were examined during the course of the field study. Active mining operations contributed 71 percent of the total discharge volume and over 50 percent of the chemical loadings found. Inactive or abandoned strip and underground (drift) mines contributed to the remainder of the mine drainage pollution to the Upper Cheat River watershed.

Discharges from twelve principal mine drainage sources contributed 85 percent of the total net watershed acid loading entering receiving streams at the time of the study.

Mine drainage loadings
by source type
Upper Cheat River, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Preparation Plant (active)	3	4,037	3,140	663
Strip mine (active)	4	13	128	19
Strip mine (inactive)	29	620	1,848	208
Drift mine (active)	15	272	6,605	1,393
Drift mine (inactive)	40	237	5,055	1,184
Strip and Drift combined (inactive)	4	862	1,720	515
TOTALS	95	6,041	18,496	3,982

Shavers Fork Watershed, W. Va.

The Shavers Fork watershed drains 210 square miles of southeastern West Virginia.

The water quality of Shavers Fork watershed is generally good throughout the basin with no coal mine drainage in the upper one-third of the watershed.

Some fifty mine sites and an estimated 170 acres of strip mined area were investigated. Samples were collected from 31 drainage sources which were discharging at the time of the survey. Discharges from the coal mine sources totalled 2.4 million gallons per day. Acidity values ranging from 4 mg/l to 130 mg/l were found in the effluents.

Three active mining operations were examined during the course of the field study. Active mining operations contributed a very small percentage of the total discharge volume and chemical loadings found. Inactive or abandoned strip, auger and underground (drift) mines are the principal mine drainage pollution sources in the Shavers Fork watershed.

Discharges from four principal mine drainage sources were found to contribute 85 percent of the total watershed acid loading discharged to receiving streams at the time of the study.

Mine drainage loadings
by source type
Shavers Fork, West Virginia

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Strip mine (inactive)	5	148	11	4
Drift mine (inactive)	20	1,161	512	37
Drift mine (active)	2	41	8	0
Strip and auger mines combined (inactive)	3	331	280	48
Strip and drift mines combined (inactive)	1	2	1	0
TOTALS	31	1,683	812	89

Black Fork-Blackwater River, West Virginia

The Black Fork-Blackwater River watershed drains 140 square miles of eastern West Virginia.

The water quality of this drainage area is affected by acid mine drainage primarily from Beaver Creek and North Branch, tributaries to the Blackwater River in the vicinity of Davis, West Virginia.

Some 121 mine sites and an estimated 1082 acres of surface mined area were investigated during this study. Samples were collected from 76 drainage sources, 51 of which were discharging at the time of the survey. Discharges from the coal mine sources totalled 3.6 million gallons per day. Acidity concentrations ranging from 12 to 4320 mg/l were found in the mine water.

Three active mining operations were examined during the course of the field study. Active mining operations contributed only a small percentage of the total discharged volume and chemical loadings found. Inactive or abandoned strip and underground (drift) mines are the principal mine drainage pollution sources in the Blackwater River watershed.

Discharges from nine principal mine drainage sources contributed 86 percent of the total watershed acid loading entering receiving streams at the time of the study.

Mine drainage loadings
by source type
Black Fork-Blackwater River, West Virginia

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Drift mines (inactive)	19	1,420	5,223	526
Strip mines (inactive)	29	1,019	8,190	1,299
Strip mines (active)	2	60	820	140
Strip & Auger mines combined (inactive)	1	1	0	0
TOTALS	51	2,500	14,233	1,965

Lower Youghiogheny River, Pennsylvania

The Lower Youghiogheny River watershed drains 266 square miles of the northern end of the Monongahela basin in Pennsylvania.

The water quality of the Lower Youghiogheny River watershed is degraded over nearly its entire length primarily as a result of mine drainage received upstream of this drainage unit.

Some 271 mine sites, an estimated 48 acres of mine refuse, 20 acres of subsidence area, and 732 acres of surface mined area were investigated during this study. Samples were collected from 110 drainage sources, 106 of which were discharging at the time of the survey. Discharges from coal mine sources totalled 20.9 million gallons per day. Acidity concentrations from 0 mg/l to 2146 mg/l were found.

Eight active mining operations were examined during the course of the field study. Active mining operations contributed 35 percent of the total mine discharge volume, 24 percent of the total acidity loading, and 30 percent of the total iron loading. Inactive or abandoned strip and underground (drift) mines contributed most of the remainder of the mine drainage pollution.

Discharges from thirteen principal mine drainage sources contributed 85 percent of the total watershed acid loading entering receiving streams at the time of the study.

Mine drainage loadings
by source type
Lower Youghiogheny River, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Drift mines (active)	1	3	7	0
Drift mines (inactive)	44	9706	37,390	10,654
Strip mines (active)	2	101	579	9
Strip mines (inactive)	29	1078	10,923	788
Shaft mines (active)	1	1962	17,187	5,269
Shaft mines (inactive)	2	12	41	0
Strip & Drift mines combined (active)	1	1	-3	0
Strip and Drift combined (inactive)	25	1268	6,414	750
Auger mines (inactive)	1	383	2,782	152
TOTALS	106	14,514	75,320	17,622

Sewickley Creek Watershed, Pennsylvania

The Sewickley Creek watershed is composed of the main stream, two major tributaries, and numerous small tributaries which drain 169 square miles of southwestern Pennsylvania. The area has been extensively mined in the Pittsburgh coal seam from which high grade coke was made. At present only four active mines exist as most of the readily accessible coal has been mined out. Many large abandoned underground mines produce acidic and mineralized drainage.

The water quality of Sewickley Creek is seriously degraded over nearly its entire length as a result of coal mine drainage, with only the headwaters free of pollution.

The two major Sewickley Creek tributaries are polluted with acid mine drainage, however, they are not as severely polluted as Sewickley Creek proper.

Some 237 mine sites of all types were examined in the field. Samples were collected from 58 drainage sources, 54 of which were discharging at the time of survey. Discharges from the coal mine sources ranged from 1 to 5310 gallons per minute and totalled 23.1 million gallons per day. The acidity concentrations ranged from 22 mg/l to 571 mg/l. The mine discharges consistently carried high hardness, sulfate and iron loadings to the streams in the drainage basin.

Four active mining operations were examined during the course of the field study. Active mining operations contributed about one-third of the total discharge volume and chemical loadings measured.

Five principal mine drainage sources contributed 85 percent of the total watershed acid loadings discharged to receiving streams at the time of the study.

Mine drainage loadings
by source type
Sewickley Creek, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Drift mines (inactive)	30	5,042	29,845	9,763
Drift mines (active)	2	187	1,481	320
Shaft mines (inactive)	8	4,293	11,181	5,931
Shaft mines (active)	1	5,310	23,850	5,869
Strip mines (inactive)	4	27	153	15
Strip mines (active)	1	37	171	2
Strip and Drift mines combined (inactive)	5	700	370	328
Strip and Auger mines combined (inactive)	1	6	66	16
Mine drains (inactive)	2	437	5,875	730
TOTALS	54	16,039	72,992	22,973

Middle Youghiogheny River Watershed, Pennsylvania

The Middle Youghiogheny River basin is defined as extending from the Westmoreland-Fayette County line to 1.5 miles north of the community of Connellsville, Pennsylvania. This portion of the river is 14 miles in length and drains an area of 152 square miles.

A total of 152 mine sites and 960 acres disturbed by surface mining operations were inventoried in the Middle Youghiogheny River basin. Included in this total were 40 drift mines, 79 strip mines, 25 combination underground-surface mines, six slope and shaft mines, and one preparation plant. Twenty-nine sites were examined with discharge volumes exceeding 0.5 gallons per minute. The total discharge volume was 689 gpm or nearly one million gallons per day. The total net acidity measured at the discharge sites was 3731 lb/day. One active strip mine discharged an acid load of only 34 lb/day. Abandoned drift mines and combination underground surface mines are the principal acid contributing sources. The acid load discharged by these sources was 1847 lb/day and 1801 lb/day respectively, or about 98 percent of the total basin load. Nearly the entire iron load measured in the basin, 608 lb/day, emanated from these same sources.

The majority of the streams in the basin receive some mine drainage. Only the eastern and north-central portions of the basin are relatively free from mining operations and attendant stream effects. The majority of the discharges are received by Galley Run and several tributaries to Jacobs Creek.

Coincident with the mine drainage source investigation, a stream sampling station near the mouth of Jacobs Creek was sampled 16 times. On eleven of these sampling dates the alkalinity concentration exceeded the acidity concentration. On only one occasion was the alkalinity concentration completely depleted. The average alkaline load for the sampling period was 7240 lb/day while the acidity load averaged 4337 lb/day.

Mine drainage loadings
by source type
Middle Youghiogheny River, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Drift mines (inactive)	13	350	1,847	365
Strip mines (active)	1	2	34	4
Strip mines (inactive)	8	13	49	3
Strip & Drift mines combined (inactive)	7	324	1,801	236
TOTALS	29	689	3,731	608

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Mounts Creek and Indian Creek Watersheds, Pennsylvania

Mounts Creek extends eleven miles northeastward from the community of Connellsville, Pennsylvania and its basin covers approximately 32 square miles. Indian Creek extends eighteen miles northeastward from its confluence with the Youghiogheny River about five miles southeast of Connellsville. Its basin drains 130 square miles and lies adjacent to the Mounts Creek basin.

Mining operations in the Mounts Creek basin have been limited to nine individual sites. Discharges in the Mounts Creek area may occur seasonally, however, none were inventoried during the survey period.

Extensive mining activity has occurred in the Indian Creek drainage area. Approximately 80 drift mines and 27 strip mines were inventoried. Disposal of mine water is reported to have been a problem since the earliest mining because of the reservoir located on Indian Run downstream of the mining activity. As a result many of the mines are served by a drainage system which includes underground transit through the highly interconnected mine workings, surface structures such as pipes and flumes, and finally passage via tunnel to a discharge point located below the reservoir site. Acidity and iron loadings measured at the discharge point were 8971 lb/day and 1425 lb/day, respectively. Portions of this drainage system are currently in disrepair, but presumably not beyond the point of reconstruction for its designed purpose.

The principal portion of the total basin acid load, 8404 lb/day, results from an active drift mine located at Melcroft. The 7215 lb/day acid load from this mine discharges into the above mentioned drainage system and constitutes the major portion of the acid load measured at that point.

Stream sampling and gaging near the mouth of Indian Creek show the stream to be consistently acid. On all but three of the sixteen sampling occasions, alkalinity concentrations were zero and in all cases a net acidity remained. The average acidity load carried by Indian Creek near its mouth approached 10 tons per day while the iron load was approximately 1.2 tons per day.

Mine drainage loadings
by source type
Mounts Creek and Indian Creek, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Drift mines (active)	6	522	7,370	1,106
Drift mines (inactive)	34	115	904	110
Strip mines (active)	1	1	1	0
Strip mines (inactive)	8	35	129	24
TOTALS	49	673	8,404	1,240

Youghiogheny River West Watershed, Pennsylvania

The Youghiogheny River West watershed is defined as extending from the community of Confluence, Pennsylvania, to a point about 1.5 miles downstream from the community of Connellsville, Pennsylvania. This portion of the river is 30 miles in length and embraces a drainage area of 187 square miles.

Mining operations along the mainstem Youghiogheny River are absent above the community of Ohiopyle. Areas of mining operations are located north of Confluence, the immediate area of Ohiopyle, the south Connellsville area, and along Dunbar Creek and its tributaries.

During the field inventory a total of 95 mines were examined which contained 116 openings. Included in this total are 41 drift mines, 43 strip mines, 3 combination underground surface mines, 4 slope mines, and 4 shaft mines. The 18 discharging sources contributed a combined flow of 125 gpm or 180,000 gallons per day. The total net acidity measured in the basin was 2140 lb/day. The principal sources of acid pollution are attributable to strip mines, approximately 70 percent of the basin load. However, two of the three inventoried active strip mines were engaged in the extraction of fire clay rather than coal. The acid load contributed by the clay mines was 1461 lb/day while the coal strip contributed only 5 lb/day.

The water quality of the Youghiogheny River is only slightly degraded by acid pollution entering between the communities of Confluence and Connellsville. In addition, there are isolated areas of water quality concern on tributaries to the Youghiogheny River in the above area. The major cause of the water quality degradation of the mainstem Youghiogheny River in this watershed are the acid effluents from coal mining areas received upstream of the discussion area.

Mine drainage loadings
by source type
Youghiogheny River West - Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Drift mines (inactive)	8	21	182	46
Strip mines (active)	3	64	1,466	99
Strip mines (inactive)	3	33	411	116
Shaft mines (inactive)	3	5	80	8
Strip & Drift mines combined (inactive)	1	2	1	0
TOTALS	18	125	2,140	269

Laurel Hill Creek Watershed, Pa.

The Laurel Hill Creek watershed drains 128 square miles in southwestern Pennsylvania. The stream is a tributary to the Youghiogheny River.

The water quality of Laurel Hill Creek is generally good as a majority of the streams are unaffected by mine drainage.

Twenty-eight mine sites, an estimated two acres of surface mining, and five acres of refuse and subsidence were investigated during this study. Samples were collected from 12 drainage sources, ten of which were discharging at the time of the survey. Discharges from the coal mine sources totalled 0.04 million gallons per day. Acidity concentrations ranging as high as 442 mg/l were found in the mine discharges.

No active mining operations existed in the area at the time of the study. Inactive or abandoned underground (drift) mines were the principal mine drainage pollution sources in the Laurel Hill Creek watershed.

Four principal mine drainage sources were found to contribute 91 percent of the total acid loading entering receiving streams at the time of the study.

Mine drainage loadings
by source type
Laurel Hill Creek, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Drift mines (inactive)	10	29	38	3

Casselman River Watershed, Maryland - Pennsylvania

The Casselman River watershed, draining 477 square miles of western Maryland and southwestern Pennsylvania, has been mined extensively by both surface and underground coal mining activity. These operations have left a residual of hundreds of underground voids and large surface-mined acreage capable of producing acidic and mineralized drainage.

Water quality of the Casselman watershed is seriously degraded over about two-thirds of its entire length as a result of coal mine drainage. Only the headwaters are of acceptable water quality. A portion of nearly every tributary to the main stream is affected by mine discharges.

Some 258 mine sites and an estimated 1,900 acres of strip-mined area were investigated during this study. Samples were collected from 212 sources, 175 of which were discharging at the time of the survey. Discharges from the coal mine sources totalled 10 million gallons per day. Acidity concentrations ranging from 0 mg/l to 8408 mg/l were found in the mine effluents. The mine discharges consistently carried high hardness, sulfate and iron loadings.

Fourteen active mining operations were examined during the course of the field study. Active mine discharges contributed only a small percentage of the total discharge volume and chemical loadings measured. Mine refuse areas contributed equally small percentages of the totals. Inactive or abandoned strip and underground (drift) mines are the principal mine drainage pollution sources in the Casselman River watershed.

Discharges from seventeen principal mine drainage sources contributed 85 percent of the total watershed acidity entering receiving streams at the time of the study.

Mine drainage loadings
by source type
Casselman River, Maryland, Pennsylvania

Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Drift mines (active)	6	226	1,213	192
Drift mines (inactive)	108	4,288	31,924	4,991
Strip mines (active)	2	50	75	40
Strip mines (inactive)	49	1,144	2,837	443
Strip and Drift mines combined (active)	1	164	2,273	137
Strip and Drift mines combined (inactive)	5	367	3,165	179
Shaft mines (inactive)	2	667	1,231	446
Preparation Plants (inactive)	2	7	15	2
TOTALS	175	6,913	42,733	6,430

Upper Youghiogheny River Watershed, Md.-W.Va.-Pa.

The Upper Youghiogheny River drains 444 square miles, primarily in Maryland, but includes small parts of West Virginia and Pennsylvania. No major commercial mining operations exist in the area and most mining activity at the time of the survey was by strip and drift mining methods.

The water quality of the Upper Youghiogheny area is generally good with only three tributaries significantly affected by mine drainage. Only one of these tributaries is consistently acid.

Some 92 mine sites and an estimated 240 acres of strip mining area were investigated during this study. Samples were collected from 42 drainage sources, 38 of which were draining at the time of the survey. Discharges from coal mine sources totalled 0.04 million gallons per day. Acidity concentrations ranging from 0 to 376 mg/l were found.

Only six active mining operations were examined during the course of the field study. Active mining operations contributed only a very small percentage of the total discharge volume and chemical loading.

Inactive or abandoned strip and underground drift mines are the principal mine drainage pollution sources in the Upper Youghiogheny watershed.

Discharges from seven principal mine drainage sources were found to contribute 88 percent of the total watershed acid loading discharged to receiving streams at the time of the study.

Mine drainage loadings
by source type
Upper Youghiogheny River, West Virginia
Pennsylvania, Maryland

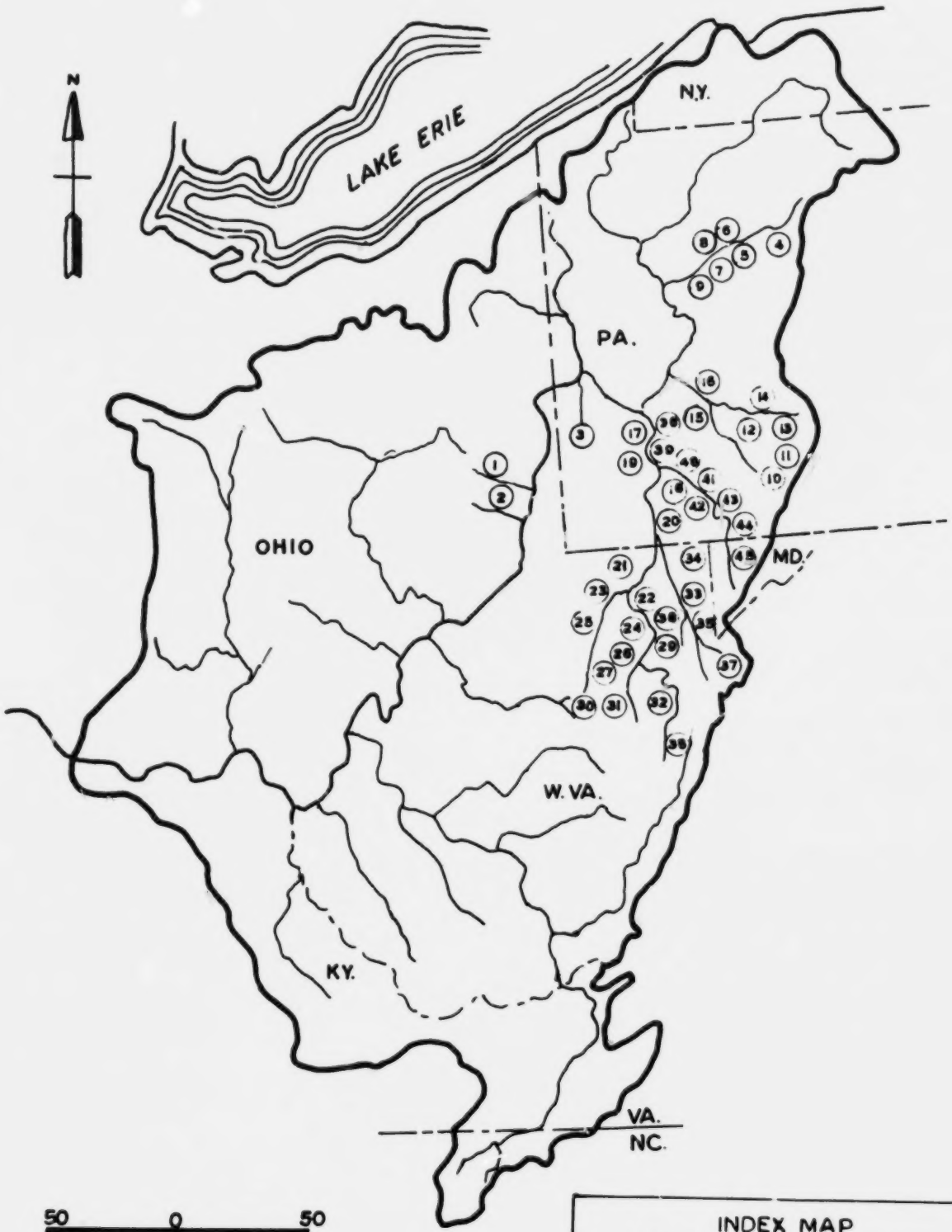
Source Type	No.	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Strip mines (inactive)	16	104	624	45
Drift mines (active)	3	5	24	2
Drift mines (inactive)	15	148	1,012	215
Strip and Drift mines combined (inactive)	4	44	53	1
TOTALS	38	301	1,713	263

Table I

Summary of Mine drainage loadings
selected areas, upper Ohio River Basin

Area	No. Discharges	Total Discharge (gpm)	Total Net Acidity (lb/day)	Total Iron (lb/day)
Minor tributaries to Ohio River	226	12,026	182,629	25,186
Clarion River tributaries	501	16,495	153,443	13,026
Kiskiminetas River tributaries	764	81,230	712,193	*
Monongahela River tributaries	2,895	145,663	1,104,830	272,763
TOTALS	4,386	255,414	2,153,095	310,975

*Data not available at this time.



INDEX MAP
UPPER OHIO RIVER BASIN

FIGURE 1

Legend for Figure 1
Index Map, Upper Ohio River Basin

Map Number	Watershed
1	Wheeling Creek, Ohio
2	Captina Creek, Ohio
3	Raccoon Creek, Pennsylvania
4	Toby Creek (Elk County, Pennsylvania)
5	Mill Creek, Pennsylvania
6	Toby Creek, (Clarion County, Pennsylvania)
7	Piney Creek, Pennsylvania
8	Deer Creek, Pennsylvania
9	Licking Creek, Pennsylvania
10	Stony Creek, Pennsylvania
11	Little Conemaugh River, Pennsylvania
12	Conemaugh River, Pennsylvania
13	Blacklick Creek, Pennsylvania
14	Two Lick Creek, Pennsylvania
15	Loyalhanna Creek, Pennsylvania
16	Kiskiminetas River and Minor Tributaries, Pa.
17	Lower Monongahela River and minor tributaries, Pa.
18	Redstone Creek and Dunlap Creek, Pa.
19	Ten Mile Creek, Pennsylvania
20	Middle Monongahela River and minor tributaries, Pa.
21	Dunkard Creek, Pennsylvania-West Virginia
22	Upper Monongahela River and minor tributaries, Pennsylvania - West Virginia
23	Buffalo Creek and Paw Paw Creek, West Virginia
24	Lower West Fork River, West Virginia
25	Ten Mile Creek, West Virginia
26	Elk Creek, West Virginia
27	Upper West Fork River, West Virginia
28	Lower Tygart Valley River, West Virginia
29	Middle Tygart Valley River, West Virginia
30	Buckhannon River, West Virginia
31	Middle Fork River, West Virginia
32	Upper Tygart Valley River, West Virginia
33	Lower Cheat River, Pennsylvania-West Virginia
34	Big Sandy Creek, Pa. - W. Va. - Md.
35	Upper Cheat River, West Virginia
36	Shavers Fork, West Virginia
37	Black Fork - Blackwater River, Pennsylvania
38	Lower Youghiogheny River, Pennsylvania
39	Sewickley Creek, Pennsylvania
40	Middle Youghiogheny River, Pennsylvania

Legend for Figure 1
Index Map, Upper Ohio River Basin (continued)

Map Number	Watershed
41	Mounts Creek and Indian Creek, Pennsylvania
42	Youghiogheny River West, Pennsylvania
43	Laurel Hill Creek, Pennsylvania
44	Casselman River, Pennsylvania - Maryland
45	Upper Youghiogheny River, West Virginia - Pennsylvania - Maryland